THE
ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE EMERGENCY BRAKE.

FROM time to time we have alluded in a somewhat mysterious manner to a brake, of which we had great hopes that it would fulfil the ideals which we set before our readers. So many accidents, involving injuries and deaths, occurred within so short a time, that not only the daily Press became alarmed and queasy about the safety of all tramcars, and we felt bound to urge upon the responsible officials of tramways the crying need for individual inquiries into the probable efficacy, under panic conditions, of the various brakes on their cars. We have said, and others have echoed it, that any of the brakes in general use is good enough under quite ordinary circumstances, but we think that all the accidents of any note have been due to some little oversight or carelessness on the part of the driver, or perhaps to a slight derangement of some part of the equipment, which in the flash of a moment has developed into material for a catastrophe. At one second the car's speed is within the control of a cool man, to whom the brakes have become merely an extension of himself; in the next, the speed has passed the critical point, because the cool man is not there, and nothing but a miracle can stop the car, for the driver has at hand three or four brakes which have almost as little effect when used badly as if they had not been used at all.

"Simplicity with certainty" is our motto where brakes are concerned, and it is far better to take away all chance of confusion than to strive after a staff of which all the members are so perfectly balanced as never to be confused even when offered the use at one and the same moment of three powerful brakes, each sufficient in itself, under most circumstances, to stop a car, but all mutually destructive if applied simultaneously without discretion.

No matter what all the engineers in all the world may do, Providence will not abandon the emergency as a trial of nerve and skill. We may make it rather more difficult to find an opening, but we shall never reach that blissful state in which our eyes can be taken for an instant from the scrutiny of that apparently blank wall of safety, lest at any point an emergency should break through like a bomb.

An emergency being in the nature of a sudden occurrence, the anti-emergency must be brought into action as instantaneously as possible if it is to be really useful. In the case of a runaway car the driver must know that by moving a lever, or by pressing a button, or by making some other very simple movement, about which there can be no question as to a right or wrong direction, or a right or wrong speed, the emergency brake will be applied on the instant and at its maximum power. This brake must not be capable of graduation, and the responsibility of the driver may be taken to cease from the moment that the brake is applied. From then the brake takes control, and

stops the car within some distance, which must vary with the momentum of the car and the contour of the track.

We suppose that a brake could be made which would stop a car running at 30 miles an hour, on a grade of 1 in 12, within a foot or two; but that sort of retardation would be worse for car, passengers, and track than the accident, and there is no need at all for a brake of such terrific power. The least that we ask of an emergency brake is that it shall come into action instantaneously, and the most that we ask is that it shall bring the car to a standstill within a reasonable distance without hurting the passengers, and, if possible, without damaging the equipment, although the latter consideration is of little moment when lives are at stake.

Perhaps we shall not be taking too much credit to ourselves in assuming that our articles on Brakes had more than a little part in shaping Mr. Pringle's ideas, from the time when he first thought seriously of himself providing a solution of the emergency-brake problem, until that thought had become materialised in his first completed design. If that assumption be true, we take more than common pleasure in congratulating Mr. Pringle upon the success of the trials which were carried out during the second week of April in the presence of representatives of the leading electrical and traction journals; and we may say now that the articles to which we refer in the opening sentence of this article were written in the light of an intimate knowledge of the experiments which Mr. Pringle has been carrying out during the past 12 months or more. The final tests confirm the results we have published already, and raise the performance of the brake to an even higher level in our opinion than it had attained before.

We print on another page an illustrated description of the latest form of this brake, and we are able, by the courtesy of the inventor, to show by sketches its evolution from the earliest form.

Of course, we must not be considered as sponsors to this brake more than to any other contrivance which we take occasion to notice with more or less favour at any time. All we can say is that the brake seems to fulfil those requirements which we have set down as essential in an emergency brake pure and simple, and the latest tests—the first of a public character—were merely the last in a long series, in the course of which the inventor has reduced the apparatus to what seems like the highest degree of simplicity, and has chosen, after a chastening succession of failures, the most suitable materials for each part. It now remains for him to induce the tramway managers of the kingdom to understand what grave risks, and what heavy moral responsibilities, they continue to incur so long as they do not make it impossible for accidents, such as those which took place at Highgate, Bradford, Halifax, and a host of other towns, to happen on their lines too.

Electric Supply Charges.

The paper which Messrs. Handcock and Dykes read before the Institution of Electrical Engineers on the 9th inst. recalls the necessity of considering the existing methods of charging for the supply of electrical energy. The advent of the metallic filament lamp has been the cause of serious panic amongst suppliers of electricity, a panic which invariably occurs in all classes of industry when old methods are revolutionised by the introduction of anything having a cheapening effect upon a saleable commodity. It is well known that the past year has been a trying one for most electricity undertakings, partly on account of the introduction of the new lamps, and partly on account of the coal "boom"; but the full extent of the trouble has not yet been reached, although we may anticipate it in the immediate future when the fuller development of the possibilities of the new lamp reaches the market. It behoves every engineer to profit by the temporary respite, and to prepare for the inevitable diminution of revenue from lighting sales that is bound to prevail for some time to come, a period during which we must anticipate adverse balances in electricity accounts, but in which considerable progress will be made and the use of electrical energy for all purposes will become more universal. However, we cannot but again express our apprehension on account of those undertakings which were established primarily for the supply of electric light, but are supplying energy for power purposes at unremunerative prices.

Considering the importance of the subject, it is to be regretted that it should have been treated by the authors in a manner which we must describe as somewhat superficial. In this paper the evil is diagnosed and a remedy prescribed, but it is doubtful whether the remedy is better than the evil. The authors apparently have viewed the case simply from a lighting point of view, and in their endeavours to avert financial loss on account of lighting they rush to the opposite extreme with regard to power, and propose to penalise power users for the benefit of lighting consumers. It is difficult to believe that the authors have given more than superficial consideration to the subject, when they base their charge for all classes of supply upon a common diversity factor. In the industrial area of London, the power-load has a diversity factor that may safely be placed at 3·3; yet, to quote the paper, "by taking 990 KW. (the sum of the consumers' 'contract demands'), instead of 713 KW., the maximum load on the station feeders, the consumer gets *due* allowance for the diversity factor." No doubt this would be a simple method of charging, but, unfortunately, for the authors, the result is shown by their own example in which the energy supplied to a 10-H.P. motor, working 50 hours per week, is charged at 2·86d. per unit.

Reviewing the paper generally, we are surprised at the loose manner in which examples are stated. In one instance, "A has an equivalent of 60 lamps of 8 C.P. and consumes 655 units, and the 'contract demand' is fixed at 0·9 KW.," presumably 50 per cent. of the possible maximum, and in comparison "B has an equivalent of 55 lamps of 8-C.P. and consumes 350 units, and the 'contract demand' is also fixed at 0·9 KW.," so that, although B consumes less energy than A, he is charged in his contract 54½ per cent. of his possible maximum, whereas A is charged only 50 per cent.

Tramways are assumed to have a 41 per cent. load-factor, which is considerably higher than can be obtained in actual practice, and the contract demand for supplying energy to a 10-H.P. motor is stated at 10 KW.

"The man who wires his house for, say, 1,000 lights, thereby entailing a considerable capital outlay on the part of the supply company owing to their liability to supply him at any moment, and may tender the company the magnificent sum of 13s. 4d. per quarter," might be regarded as a fitting candidate for admission to an institution where such a number of lights are likely to be utilised.

We trust that this subject will not be allowed to lie in abeyance after the usual discussion, but that steps will be taken by the Institution to formulate a system of charging for all classes of supply with logic for its basis and equity for its aim.

ELECTRICITY AT THE FRANCO-BRITISH EXHIBITION.

[COMMUNICATED.]

JUST as you were going to press last week you learned that the proposed co-operative electricity exhibit (the plans for which were announced in the ELECTRICAL REVIEW of the 3rd inst.) had definitely fallen through. In plain words, this means that the British electrical industry will not be represented at the largest exhibition of its kind since 1852; it is, perhaps, futile at the present date to enter at any length into the probable causes of the failure of the scheme. The opinion was early expressed that it was useless to show plant, &c., at a popular exhibition. Owing, therefore, to the few applications for space, a proposal for a co-operative exhibit was made and taken up conjointly by a committee having as its component parts the Institution of Electrical Engineers, the London Supply Companies, and some representative manufacturers. Whether the old adage about the multiplicity of chefs holds good in the present case, it is impossible for us to say with the knowledge that is before us. It is certain, however, that if anything is to be done it must be done promptly. The exhibition opens in May, but will not be completed until the end of that month; there are, therefore, some five weeks available, and much can be done in that time. But who, it may be asked, is to step into the breach? The answer is obvious; the London Electric Supply Companies ought to take the initiative and run an exhibit of applied electricity, which will benefit them much more than an exhibit of plant, and will also attract the public. The municipal authorities may be left out of account, as the Local Government Board refused to allow them to subscribe to the co-operative scheme. We understand that the gas undertakings have formed a central committee, which has collected some £3,400 by means of a circular letter addressed to the various undertakings throughout the country, such small sums as £5 from provincial suppliers having gone to swell the total. With this sum a demonstration of lighting, cooking, and heating by gas will be given, the apparatus being lent or given by the makers.

There is not time at the present moment to circularise all the electrical supply companies of the country, but will the London companies let this stand in the way, and allow the gas companies a free field? There should not be any difficulty about the money; any two or three of the companies could find all that would be required in the first instance in order to save time, and the hat might be sent round afterwards if necessary, when we do not doubt that there would be a ready response. In case the companies have no scheme ready, the writer would suggest the following, which would, at any rate, be a cabbage-field for them to build on. The space, or part of it, on which the co-operative committee had an option is no doubt still available and could be acquired for a comparatively low figure. Let the companies place a contract with one of the large furnishing firms for a single-storey building having many rooms, the whole being built of light materials. This would not cost more than £750 with simple decorations, but the contractors might be induced to do it for less if they were allowed to furnish the rooms throughout and thus receive a free advertisement. The wiring would be a simple matter, plenty of plug and ceiling points being provided capable of taking currents for all sorts of domestic requirements, *e.g.*, lighting, heating, cooking, small motors for dinner lifts, &c., and (where necessary) large ranges. The apparatus would, perhaps, be supplied on loan willingly by the manufacturers, the lamps being given. Facilities could be arranged for the distribution of the manufacturers' publications, or the display of their showcards.

Apart from the rent and building, the other expenses would be wiring and fixing, attendance and current. The first three could be carried out by a staff selected from the companies, or the wiring and fixing might be put in the hands of a contractor of repute; the current would, of course, be supplied by the local undertaking and paid for out of the common fund.

This is a rough outline of what might be done without any difficulty if a few strong men would take the matter up energetically and act at once. The writer appeals to the Electric Supply Companies of London to do something to save the situation.

CORRESPONDENCE.

***Letters received by us after 5 p.m. on Tuesday** cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Proposed Engineers' Association.

May I thank Mr. Penn for his kindness and courtesy in laying before us in so much detail the many advantages of the Association of Engineers-in-Charge; his eloquent, restrained, and thoughtful pleading make me feel extremely sorry that, at any rate as yet, I cannot see much benefit in becoming a member, although I can happily boast that I am qualified to do so, being first and foremost a shop-trained man, with a subsequent technical college training.

I think that the reason another association is required is that the men which the Association of Engineers-in-Charge represents are, in the majority of cases, in different circumstances to what central station men are in. The great difficulty with the Poor Law engineer has been that he has worked under, and been controlled by (in the majority of cases), a medical superintendent or some other *non-engineering* official. Thus it has been in his case a matter of educating the layman to realise the responsibility of the engineer's office, and so to pay and treat him well.

Now we central station assistants are working under chiefs who are (or are supposed to be) engineers, and who know and realise to the full the responsibilities of our posts, but who systematically keep down our salaries and keep us under conditions, in many places, which they simply dare not offer to their labourers. So that the Poor Law engineer is ill-treated by an outside class *who do not understand the responsible nature of his office*, and to that extent they may be somewhat excused and also educated.

Now our chiefs know our responsibilities, and in spite of this knowledge, they do not in the majority of cases treat their assistants properly, in fact, the treatment deserves the term abominable. So that, and here lies the great point, *we are betrayed by our own class*, and are treated dishonourably and meanly by the men to whom we should be able to look up for example and guidance.

Lest it be thought that I write smarting under personal wrong, let me hasten to say that I am, on the whole, very fairly placed and have no immediate cause to growl, but the majority of my fellows are placed very much otherwise, and I have seen blame cruelly shifted on to another's shoulders, although so far it has hardly touched mine; some chiefs are all that could be desired, but these men are in a hopeless minority.

One phase in Mr. Penn's letter is of exceptionally happy and honourable significance in my eyes, viz.:—"And in accordance with those methods, which all well-thinking Englishmen admire." Yes, Mr. Editor, I fully approve of those methods and should never think of using any other, and I also realise to the full the fact that it is to be regretted that in most cases we cannot look to our chiefs as to elder brothers; the reason we cannot give them the respect and sentiment which this condition would inspire, is that in most of their dealings they use "those methods which every well-thinking Englishman" *despises*.

Assistants certainly have their share of faults, and I should be the last to ignore this, but I myself have met certain chiefs as man to man, and many others whom I know have done the same. We have been perfectly reasonable, perfectly (perhaps too) candid, and more than once I have had to go solely by myself, and for myself to try to reason over matters, my colleagues simply refusing to move, although they have cried out more than myself; and what, in the majority of cases, has been the result? We have forced the

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chief into a corner, and "he has sheltered behind the committee," and yet when in course of time it has been possible to see committeemen, one finds that they have never had the matter mentioned to them, and have very often met one half way—at any rate, when a full explanation has been given them.

It is undoubtedly the station man's fault that he is in his present position; but, Mr. Penn, try to combine a few men, and you get nonsense about "beneath our dignity," &c., as if there is any dignity in belonging to a profession the members of which are simply kicked about from pillar to post, as so much rubbish. Again, as pointed out above, one cannot regard as one's friend, a person who is obviously doing his best against one's interests, in order to further his own.

I regret that there is any need for such an Association as that which has been talked about, but the need is there, and is urgent. We do not need to go in a drastic or dictative manner to chiefs, but we do need to be in a position to take drastic measures should these be necessary. We need the "iron hand within the velvet glove," and I am convinced that the time has arrived when, with certain chiefs, we must take the gloves off.

That we shall have heavy toil and bitter disappointments at first, I recognise and am willing to face; that we shall suffer from disloyalty amongst our own body (*i.e.*, other assistants) is sadly too true, for no profession is so saturated with disloyalty to one's fellows as is ours. That we have already self-seeking lunatics in the camp is evident from this week's Review; therefore, Mr. Penn, if you can further show us where you can benefit those of us who are outside London, apart from the educational aspect, I shall seriously consider applying for membership. The educational aspect is very valuable, but we need a fighting organisation as well.

I have all the numbers of the *Engineer-in-Charge*, and am a regular contributor to its "Power Plant Problems" columns. Should you desire it, the Editor is at liberty to give you my name, address and place of work.

Thanking you, Mr. Editor, for the kind way in which you have put at our disposal your valuable space.

Combine.

April 10th, 1908.

Modern Views of Electricity.

Permit me to thank your reviewer for his friendly and modestly-worded notice of my little book in your issue of April 10th, but, to avoid misunderstanding, may I explain that, to the best of my recollection, I have never said that I regarded the ether as "structureless." We do not know its structure, but that it must have a kinetic structure of some kind—although in itself absolutely continuous—is my definite conviction.

Oliver Lodge.

Italy, *April 18th*, 1908.

Measurement of Illumination.

In connection with the correspondence which took place on the above subject, in your columns some months ago, it seemed to be fairly well agreed that the horizontal illumination formed the best criterion of outdoor lighting. A doubt, however, appeared to prevail in some quarters, as to whether the illumination, as measured on the horizontal screen of a portable photometer, was the true horizontal illumination, and I, further, ventured to question the correctness of calculating the horizontal illumination from the measured candle-power of the lamps.

The results given herewith are of interest in connection with these two questions:—Fig. 1, which is plotted from figures taken by Mr. R. Ellis, clearly shows, I think, that with a good screen, the agreement with the Cosine law, even at the very smallest angles, is well within the experimental error, and is, for practical purposes, almost perfect. The photometer used, was the ordinary Trotter "Universal" pattern, and the dotted curve shows the calculated illumination, assuming the Cosine law, while the points marked with crosses, represent the measured illuminations to an arbitrary scale.

Having satisfied myself that the photometer screen could be relied upon accurately to follow the law, I wished next to determine how nearly the lighting in a street, for example,

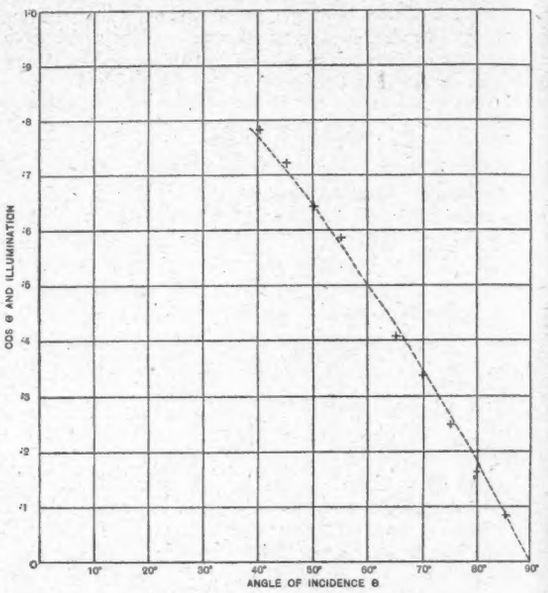


Fig. 1.—Comparison of Measured and Calculated Horizontal Illumination.

could be regarded as emanating from a point; or, in other words, whether it was safe to calculate the horizontal illumination from a measurement of the direct illumination.

The results of some tests taken with this idea in view are as follows:—

Situation.	Angle of incidence. θ	Direct illumination. $\times \cos\theta$	Measured illumination in ft.-candles.	Difference per cent.
St. James' Park	0°	0·14	0·14	—
	34°	0·116	0·12	3·3
	79° (hztl.)	0·027	0·03	10
Oxford Street	0°	0·33	0·33	—
	30°	0·285	0·255	12
	75° (hztl.)	0·0855	0·1	15
	90°	0	0·02	∞

The direct light from all other lamps was in each case carefully screened from the photometer, and from these figures it will be seen that, in comparatively open positions, such as St. James' Park, the calculated illumination is, as might be expected, not very different from the observed, except at large angles of incidence. In streets, on the other hand, owing to reflection from buildings, and so forth, the divergence is so great as to render it almost imperative to measure the horizontal illumination direct, rather than to attempt to calculate it from candle-power or "direct illumination" measurements.

It will be noticed that at an angle of incidence of 90° the illumination, instead of being zero, as should theoretically have been the case, was still ·02 foot-candle, or 6 per cent. of the "direct illumination."

Kenelm Edgcumbe.

London, N.W., *April 11th*, 1908.

Wiring Systems.

May I trespass upon your valuable space in the hope that I shall learn the opinion of some of your readers on a matter of rather considerable importance to a good many wiring contractors, who, like myself, have to cater for the speculative builder of small private houses. The question I wish to ask is, "Which is the best method of enclosing the wires under these conditions?" The screwed steel tubing system is, of course, the ideal one, but is quite out of the discussion, as none of these builders will pay for it.

There remains then, practically, only slip-joint tubing and wood casing to choose from, and as I have recently

heard each denounced in favour of the other by consulting and Council engineers, the matter seems to be open to controversy.

I, myself, incline to the casing, provided good quality cable is used, for the reasons that the wiring may be kept out of the reach of floor brads and other nails, and that joists and partitions need not be weakened as in the case where, with tubing, slotting is necessary. The great drawback, in my opinion, to the slip-joint tubing is the difficulty of efficiently earthing the whole of it.

A. Venables.

London, N.W., *April 13th*, 1908.

[There are also the surface-wiring system, using insulators, and the rubber-insulated lead-covered twin-wire system—both inexpensive and each possessing important advantages. —Eds. E.R.]

Carbon Brushes for Turbo-Generators.

We are interested in reading the letter appearing in your issue of the 10th inst. over the name of Siemens Bros.' Dynamo Works, in which they state that, in order to bring about a successful result, radical departures from the ordinary design of commutator are necessary.

We have had a large and extended experience of the use of carbon brushes, with dynamos and motors of all kinds, and are prompted thereby to add for the information of your readers that a great deal can also be done by proper design of brush and brush-holder. In our opinion, the bad results which are sometimes found in the use of carbon brushes are due to a lack of consideration in this respect. For instance, the size of the brush is frequently absurdly large; whereas, to get the best possible results, it is necessary to divide the carbons into comparatively small brushes, in order to imitate more or less the action of metal brushes. One has only to imagine what would be the result of using a solid metal brush to understand the comparison between using a large and a small carbon brush.

There is no difficulty whatever in designing the brush-gear with this object. We have a case under our own control where Henrion brushes having a section of but ¼ sq. in. are working at a current density up to 100 amperes per sq. in. with the greatest satisfaction. The capacity of the machine is 400 amperes, and it is working with this current under voltages varying from 250 down to zero. The speed of the machine is 2,000 R.P.M., and the commutator is of the ordinary cylindrical type without any special ventilation.

It would appear that, with the adoption of brushes of this type, together with Messrs. Siemens's ventilated commutator, the difficulty found in the use of carbon brushes on turbo-generators might fairly be expected to be overcome.

Wm. Geipel & Co.

London, S.E., *April 15th*, 1908.

The Alignment of Steam Generator Shafts.

With a certain well-known make of engine, I have noticed reports from time to time of the crankshaft having broken, and invariably the cause given is that the main shaft, when checked through engine and generator, was found to be out of line, and the fracture occurred through fatigue of the metal.

I have charge of a number of this type of engine, and I find that when all the bearings are lined up in the usual way it is impossible to obtain a bedding throughout the engine bearing next the fly-wheel, therefore the bearing becomes hot, and it is impossible to run the engine.

To overcome this difficulty the makers of the engine state that "the outboard bearing (or generator bearing) should be lifted, so that it takes more of the weight of the fly-wheel"; in some cases the bearing has to be lifted about $\frac{3}{32}$ in. before an even bedding is obtained on the fly-wheel bearing of the engine.

As this is the case when the engine is new, it undoubtedly becomes considerably more out of line when the engine has run for some time, as the wear takes place chiefly on the fly-wheel bearing of the engine.

I shall be glad to have the opinion of some of your readers who are in charge of engines, as to how far this lifting may be safely continued; personally, it appears to me that the trouble which brings about the fatigue of the crankshaft metal is faulty design, and that immediately the crankshaft is lifted out of line the trouble must commence.

On another type of engine, I have usually been able to check the line of the generator and engine shaft by slightly slacking back the coupling bolts and trying a feeler at various points round the coupling; but checking in this manner is of no use when the generator end bearing is lifted so much to begin with.

Engine Practice.

PROCEEDINGS OF INSTITUTIONS.

High-Speed Electrical Machinery.

By Gerald Stoney, B.Eng., Member, and A. H. Law, B.Eng., Associate.

(Abstract of paper read before the Institution of Electrical Engineers, *London, April 2nd*, 1908.*)*

As early as 1885 it was recognised that it ought to be possible to avoid both sparking and shifting of the brushes by a compensating winding, and such a winding through holes in the cast-iron pole-faces was tried, but the benefit was found to be very small, and it was not gone on with. It is now known that the reason of its want of success was that the ampere-turns of the compensating winding were only about three-quarters of those on the armature.

In all Messrs. Parsons's high-speed armatures the cores are smooth, or nearly so, and the windings extensively sub-divided to prevent eddy currents. Slotted cores for high-speed armatures have been used with some success, but on account of the much higher self-induction of the windings, it is impossible to obtain as good results as with the smooth-core type.

In some of the most recently built armatures of large size the conductors have been laid in slight grooves in the core. These grooves provide a means of preventing the conductors from moving, and the iron between the conductors reduces the reluctance of the air-gap to some extent. The conductors are held to the core by steel piano wire, which is immensely superior to such material as phosphor bronze.

In all the earlier dynamos the magnets were of the ordinary type, generally horse-shoe; but even when the size was limited to 200 KW. at 3,000 R.P.M., although the commutation was good when the brushes were properly set for the load, heavy sparking was experienced on large variations of load, such as is met with in the case of traction plants.

In 1903, after a series of experiments, Messrs. C. A. Parsons and Co. constructed a 300-KW. two-pole compensated dynamo working at 3,000 R.P.M., at a voltage of 500, in which the ratio of compensating ampere-turns to armature ampere-turns was as high as 2·4. The armature dimensions (with the exception of the commutator) were similar to the standard 200-KW. plant of that date, and at once remarkable results were obtained, since the machine could be loaded up to 800 KW., and when that, and even greater loads, were thrown on and off with a circuit-breaker, there was no need to alter the position of the brushes nor any excessive sparking.

This type of compensating winding is now being exclusively used by the above firm, with modifications of detail only, on all their continuous-current turbo-generators. As this compensating winding, which generally is chiefly concentrated on the pole-pieces, is made with from 2 to 2½ times the number of ampere-turns that are on the armature, there is a very large excess sufficient both to neutralise the distorting effect of the armature windings on the field, and at the same time to provide a commutating field for reversing, without sparking, the current in the coil undergoing commutation. Owing to the width of this field, the brushes need not be so accurately set, and there is a considerable range of sparkless commutation at all loads.

Since this method of compensating has no iron commutating pole, it has the advantage that there is no self-induction to cause time lag at sudden changes of load; as the field in the gap between the poles is entirely in air it instantly responds to changes of current in the compensating winding, and thus the sparking often seen when there is a sudden change of load with commutating poles is avoided and the risk of a flash-over largely reduced. Also, since there is no iron to become saturated, the commutating field is always strictly proportional to the load, and thus the trouble due to saturation causing sparking at some loads and not at others is avoided. This advantage is felt still more when the dynamo is required to give varying voltages and to commutate well at any of them without any adjustment of the compensating winding by diverters or otherwise.

The compensating winding has enabled not only the number of segments for any given voltage to be reduced, but also the ampere-turns on a given diameter of armature to be increased. This enables a larger output to be obtained for a given speed, or a higher speed to be used for a given output. Before compensating was adopted, 500-KW. at 1,800 R.P.M. was the extreme limit of size for that speed, and the machine would not carry more

than 10 per cent. overload; now we have made a 500-kw. machine running at 3,000 r.p.m., or a 750-kw. running at 1,800 r.p.m., carrying 25 or 30 per cent. overload without sparking, and 50 per cent. for a short time without injurious sparking. This has enabled the cost of the turbine to be largely reduced, and the steam consumption to be lowered by some 10 per cent.

No difficulty has been experienced in running these compensated dynamos in parallel with one another or with other types, although in all cases they are self-exciting, no separate exciter being used.

Figs. 1 and 2 show a 1,000-kw. dynamo for 500 volts running at 1,200 r.p.m., two of these being coupled to a 2,000-kw. turbine. These dynamos are for 500 to 600 volts, and carry an overload

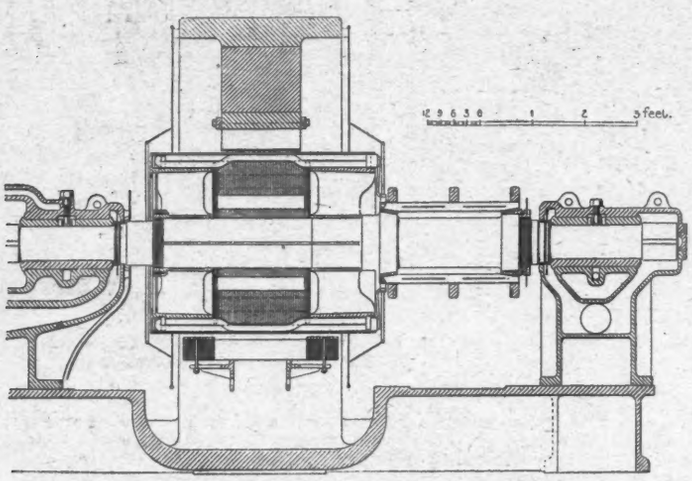


Fig. 1.—1,000-kw. Turbo-Generator, 500 Volts, 100 Revs. Longitudinal Section through Dynamo.

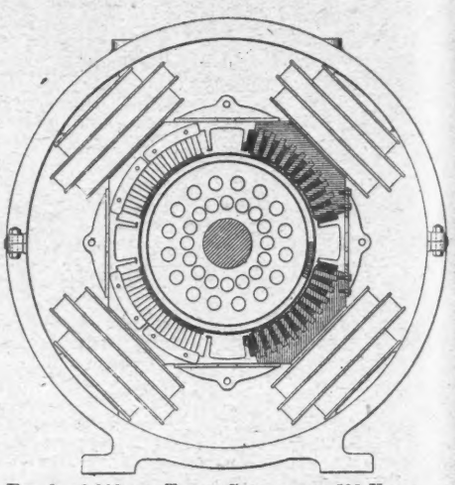


Fig. 2.—1,000-kw. Turbo-Generator, 500 Volts, 1,200 Revs. Cross-Section.

of 25 per cent. for two hours without sparking or undue heating. They are four-pole, the armature core being 36 in. in diameter and 23 in. long, with 192 conductors. The commutators have 96 segments and are 18 in. in diameter with an effective length of 24 in.

Fig. 3 is a 750-kw. dynamo at 1,800 r.p.m. for 480 to 560 volts. It is a two-pole, the core being 27 in. in diameter and 25½ in. long, the commutator having 42 segments, the diameter being 14 in. and the

rather complicates the end windings. The plant illustrated is capable of carrying 6,000 kw. for two hours, and on its official trial was loaded for half an hour up to 7,000 kw.

There are under construction at the present time two 5,000-kw. alternators for 6,000 volts at 750 r.p.m. of this type for the Sydney tramways. These machines are guaranteed to do 6,250 kw. continuously, 7,500 kw. for two hours, and to have a temperature rise not exceeding 45° F. when run continuously at full load.

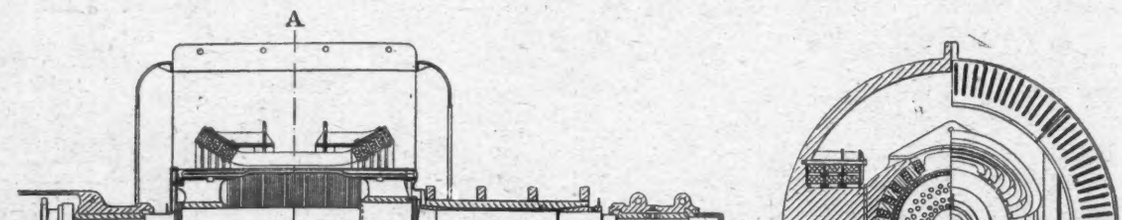


Fig. 3.—750-kw. Turbo-Generator, 480 to 560 Volts, 1,800 Revs.

effective length 33 in., and the number of conductors being 84. This machine has very good commutation, an overload of 33 per cent. or 1,000 kw. being able to be suddenly thrown on or off without any sparking whatever being visible at the brushes.

We have found brass wire brushes running on a grooved commutator to give the best results. The grooving has the advantage of increasing the surface of contact, and of allowing the brush to better follow the irregularities of the commutator.

The first turbo-alternators made were of the revolving armature type, and had smooth cores. Subsequently a tunnel winding was adopted, but the crossing of the windings at the ends makes the problem of a revolving polyphase armature difficult, especially at high voltages, though the iron loss, especially in two-pole machines, is only about one-third of what it is with a revolving field. It is impossible to sufficiently insulate the end windings and at the same time get rid of the heat generated, and as a result the modern type of revolving field has been adopted.

The design of the stationary or high-tension element follows

It is in the rotors of high-speed alternators that the greatest diversities of design are to be found. A great deal has been said as to the relative merits of salient-pole as compared with cylindrical-type rotors, especially as regards the voltage regulation of the alternators, some designers advocating the former as strongly as others support the latter, but it appears that a much more important question is whether one design shows marked advantages mechanically over the other. Any difference there may be in the two types as regards voltage regulation is certainly small, and can easily be compensated for at small expense by other features in the design.

It is necessary to make the maximum possible use of the space in the rotor which is at the designer's disposal. The material which has to be got into this space includes iron to carry the required flux; copper to carry the required magnetising current, with the necessary insulation; area to carry air ventilation, and materials included for mechanical purposes only.

The output of a given design may be regarded as directly pro-

portional to the first of these, namely, the iron, and nearly proportional to the second, the copper, so that if these can be increased at the expense of the other items a valuable saving may result. This has been effected in many cases by providing artificial ventilation for cooling the iron and copper of the stationary element.

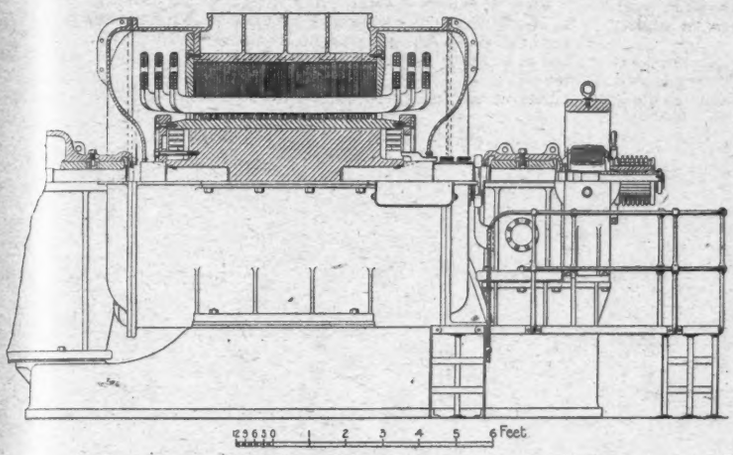


FIG. 4.—4,000-KW. 3-PHASE TURBO-ALTERNATOR WITH EXCITER, 6,000 VOLTS.

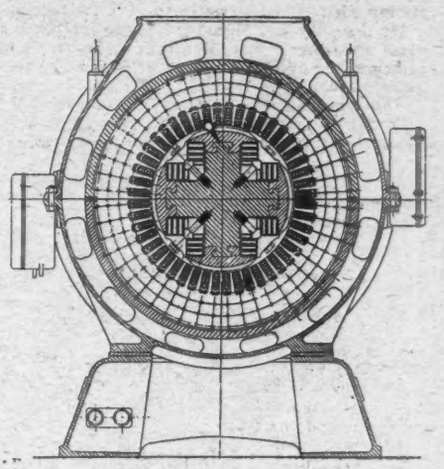


FIG. 5.—4,000-KW. 3-PHASE TURBO-ALTERNATOR, 6,000 VOLTS. CROSS-SECTION.

Among other stations, the Carville power station of the Newcastle-upon-Tyne Electric Supply Co., Ltd., has a ventilation scheme with separately driven fans, which were installed to enable the alternators to carry heavier overloads, although in the first instance the machines were run for some years with natural ventilation, and were well inside the figures guaranteed for temperature rise.

Messrs. C. A. Parsons & Co. have constructed two, four, and six-pole rotors of the salient-pole type.

In the smaller two-pole and four-pole designs a solid construction with the coils wound in place is adopted. The two-pole rotor is thus very similar in appearance to the old Siemens shuttle or H-type armature, with which many of us must have been familiar in the early days of electric lighting. The formation is excellent

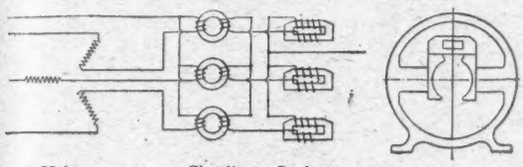


FIG. 6.—DIAGRAM OF CONNECTIONS. LEAKAGE WINDING.

mechanically, since there are few loose parts, and the solidity of the construction enables great mechanical strength to be secured. The rotor body is bored at each end and shaft ends of special high tensile steel are forced in, and then the whole is turned up and accurately balanced.

The rotor, after being balanced, is put into a horizontal winding machine, and the coils are wound into coil cases, which are made of tinned steel and completely soldered up after the winding is completed. The ends of the coil are brought out through a brass lip, soldered into the case, and fitting tightly round the connection to the next coil or to the slip rings, thus making a hermetically sealed coil. Up to the date of writing there has not been a single case among a large number of machines of a coil wound on this system becoming earthed or giving trouble in any way. A further advantage of coils thus wound and protected is the permanence of the balance of such rotors.

In the case of large rotors the pole-tips are made to slide over a tee-shaped projection on the rotor body, and the coils are wound separately in coil cases and slipped over the poles before the pole-tips are put on.

If any method of compounding the alternator to improve the regulation is adopted, much larger outputs can be obtained from a given carcass. Many methods of doing this have been proposed, but most of them depend on either commutating a portion of the alternating current or causing certain parts to become saturated as the load increases, or varying the effective resistance of the winding on the exciter magnets. A method of compounding has recently been brought out, in which the exciter is provided with an alternative path for the magnetism in parallel with the armature which we call a "leakage path." This "leakage path" is provided with a winding, which is in series with the stator winding, and as the alternating current in this rises it chokes back the magnetism, or in other words, increases the magnetic resistance of the leakage path. Thus more flux goes through the armature, and therefore the voltage of the exciter rises and compensates for the tendency of the main voltage to drop. In a three-phase alternator there is generally one leakage path in each phase, and if the primary current is at high voltage, a current transformer is generally used. These leakage paths are easily adjusted for any desired amount of compounding, or for any power factor. Fig. 6 shows diagrammatically this arrangement fitted to the exciter of a turbo-alternator, and fig. 7 gives the comparative regulation on varying load with and without the leakage path in action.

DISCUSSION.

PROF. S. P. THOMPSON, who opened the discussion, remarked on the historical character of the paper. With a view to showing the constructive progress in turbo-generators, he had analysed some of the machines referred to by the authors to obtain some statistics

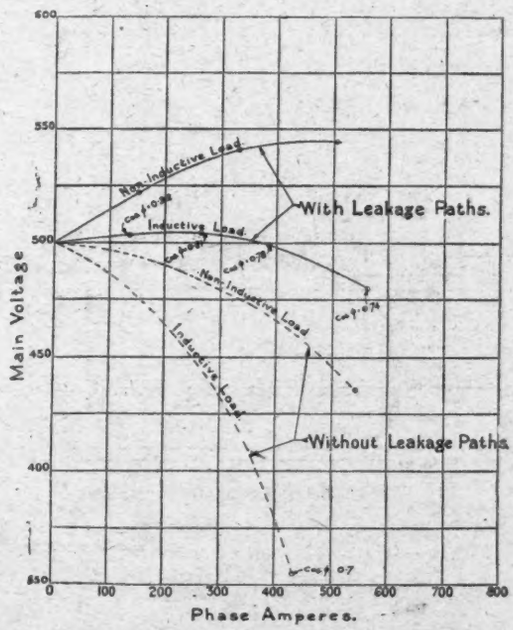


FIG. 7.—450-KW. TURBO-ALTERNATOR; VOLTAGE REGULATION, PUTTING ON LOAD. RHEOSTATS UNALTERED.

as to utilisation of materials and outputs. He had taken as the basis of comparison $\frac{\text{core diameter} \times \text{length}}{\text{KW. output}}$, and he found that in their direct-current work, the first small machine (10 H.P.) built in 1884 had a ratio of 2·4; a 60-KW. machine built in 1889, ratio 2·1; and recent machines of 750 and 1,000 KW. gave ratios of ·917 and ·828 respectively. As regards alternating-current machines, a 75-KW. unit of 1889 had a ratio 3, and a succeeding one of 150 KW. 1·76; a 350-KW. machine of 1894 gave a ratio of 2·8, and a later one of 1,000 KW. a ratio of 1·73, while the three-phase 4,000-KW. machine mentioned last gave a ratio of ·64. He thought these results showed a remarkable advance in the time. The authors'

reasons for adopting a Gramme winding in 1889 were somewhat obscure, and they later recognised the inherent defect of that arrangement. He thought good commutation was not the only reason for adopting smooth core armatures in D.C. machines; the severe iron loss in the teeth of toothed core armatures was another reason. As regards the salient pole construction of the field, he thought it more likely to lead to field distortion on inductive loads than the cylindrical rotor.

Mr. E. J. Fox considered that the smooth core armatures and ribbed commutator with wire brushes, adopted by the author's firm, would have to give way to the toothed core and carbon brush commutator. The smooth core machines ran very well, but could not be considered mechanically sound at the present day. He suggested that instead of compounding alternators it was better and cheaper to use the Tirrill regulator.

Mr. W. Parker pointed out that the construction of the authors' machines was a survival of the practice of the old lighting days, and that slotted armatures and carbon brushes were demanded by the present-day user. His firm (Siemens Bros.) were successfully operating machines embodying these features and with capacities up to 750 KW. The real difficulty with this type of machine was not commutator vibration—as that had been overcome by means of suitable brush holders, but heating of the commutator, and this could be avoided by internal cooling of the segments by means of axial slots or by external cooling. With the axial slot arrangements the temperature rise could be kept down to about 40° F. with a brush current of about 45 amperes per sq. in. He had seen machines fitted with commutating poles which fulfilled all that was claimed by the authors for compensating windings, and there was one great disadvantage with the latter, viz., that it produced a distortion of the magnetic flux probably worse than if no compensating winding were used, especially with the large number of windings used by Messrs. Parsons, and this led to flashing over. He considered that a combination of commutating poles and compensating windings represented the best and most modern practice.

Dr. Robert Pohl agreed with previous speakers as to a more modern construction being required, and as to the field distortion produced by the compensating windings employed by Messrs. Parsons. With over-compensating it was necessary to use large air-gaps and smooth cores, such as were described. He doubted whether Mr. Law's ingenious compounding idea would be a commercial success.

Mr. Miles-Walker said that cylindrical pole construction would give a larger output for weight than salient pole construction. The former gave less leakage and better cooling and a higher excitation pressure could be used. He thought the difficulty of making the end connections had stopped its use, but a satisfactory method of doing this and providing for ventilation was now available—the end connections being supported mechanically. The distributed winding on a cylindrical pole enabled a reduced sized armature to be employed. As regards compounding, he considered that any arrangement using an exciter to give the extra current, would involve a small time lag before the compounding effect took place, and this would cause a jerk on lamp circuits.

Mr. H. M. Hobart, reviewing the question of turbo-generator construction, said he considered the D.C. turbo-generator to be a dismal failure. The difficulty was to find a brush to work at the high peripheral speeds involved. He thought we were going contrary to fundamental laws; we did not want the D.C. turbo-generator above 1,000 KW. in capacity, and below this the reciprocating engine and medium-speed dynamo was the more economical combination. Above the limit mentioned turbo-alternators were usual, and the turbine was exactly suited to the alternator.

Mr. A. H. Law, replying for the authors, said that they had had such exceptionally good results with large two-pole smooth-core armature machines that they hesitated to give up that type. He agreed as to the probability of some form of carbon brush being generally used in the near future, and Parsons' commutators had sufficient surface for carbon brushes if a change were desired. As regards the compounding arrangement mentioned in the paper, the exciter magnets were somewhat larger in iron, but the copper was only slightly in excess of the standard machine. There was no time-lag in the exciter magnets, but there was a lag in the main rotor winding which would inappreciably delay compounding.

Electrolytic Corrosion.

By Prof. W. W. Haldane Gee, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers *at Manchester, March 31st*, 1908.)

The author gave the results of evidence which he had collected relating to the subject of metallic corrosion, on the convenient hypothesis that all corrosion was essentially electrolytic. He dealt first with the phenomena of ordinary electrolysis produced by an external E.M.F., commencing with anodic corrosion, and discussing the passivity of metals. It was shown that black oxide of iron was electro-negative to bright iron, and that it was very necessary to remove scale from new ironwork before painting; but a firm adherent coating of oxide was a good preservative against rust. The corrodibility of steel was increased by stress, the parts most seriously strained being attacked by galvanic action.

Serious damage had resulted to steel ships through making them fast with steel hawsers to buoys to which copper-bottomed yachts were also secured; it was necessary to avoid such connections of different metals in seawater—even cast and wrought-iron connected by rivets suffered, the rivets and wrought-iron work being corroded. Copper pipes could be protected by an iron helix, the latter being oxidised and a firmly adherent and uniform layer of oxide of iron being deposited on the copper. The use of zinc for mitigating the corrosion of steel boilers was well known. In general, zinc was the best protector of iron—better than tin.

Brass when exposed to the action of seawater would lose its zinc.

For the rusting of iron the presence of oxygen, water and carbon dioxide was essential; the carbon dioxide dissolved in water provided the necessary electrolyte to give a current with the aid of the dissimilar particles in the iron. The rust formed created with the iron a galvanic couple, and hence when a speck of rust had been formed the corrosion continued with ever-increasing speed. Solutions of soda and potash and their carbonates were a complete protection of iron from corrosion.

Lead being electro-positive to copper and brass must not be put in contact with them, even if the copper were tinned. Lead was electro-negative to iron, and should not be used to fix it in stonework.

Aluminium was preserved from corrosion by the film of oxide on its surface; but it was electro-positive to iron and copper, and must be kept from contact with them. Mechanical joints in aluminium wires must consist wholly of aluminium. Aluminium paint would stand a high temperature, and was useful for radiators, &c., but the iron must be well cleaned before painting.

In this country, thanks to the Board of Trade Regulations, gas and water pipes and electric cables were depreciated little, if at all, by stray currents. Reports of electrolytic injury to pipes came from all parts of the United States. Cast-iron water pipes suffered mainly at the joints, where 88 per cent. of the total resistance of a pipe line had been found. In this country pipe lines carried little or no current, and only a small proportion of the current caused electrolytic effects. Iron in an alkaline carbonate became passive, but chlorides were always likely to produce corrosion. A P.D. of 1 volt was not harmful.

The rate of corrosion of the overhead equipment of electric tramways had been over-estimated.

The National Telephone Co. had made surveys at Liverpool, Dundee, Sheffield, Leeds, Bradford and Hull, and found no evidence of stray currents likely to cause electrolysis.

Electrical endosmose tended to transfer water through porous materials at a rate proportional to the current, and independent of the area and thickness of the materials. Electrolysis of the alkaline salts in solution took place, and the free metals were formed, which in contact with water liberated hydrogen and might cause explosions. Experiments had been made on concrete ducts, the resistance of which was found to rise on the application of a continuous P.D. After soaking in water for two days the resistance fell to a low figure (less than 1 ohm per 100 yd., between ducts). Concrete bricks made according to the Standards Committee's specifications gave a resistance, dry, of 60,000 ohms per yard cube, but the resistance fell as low as 20 ohms when wet.

Steel embedded in cement could be electrolytically corroded at the anode, but was not corroded if coated with a good insulating paint. In the absence of stray currents iron was not only preserved in concrete, but rusty iron actually became bright.

Alternating currents could produce corrosion to a small extent—rarely more than ½ per cent. of the amount produced by continuous current.

Discussion.

Mr. Watts said that about five years ago he carried out a number of experiments on stray currents from tramway systems for the National Telephone Co. in five different towns. At Sheffield he found that at a point where a negative booster was connected, the voltage was lower than at any other point on the system. He took a number of readings in the suburbs, and found that in no case was there a greater voltage than 1·25; in the town it was anything between zero and 1·25. On the South Staffordshire tramways he found a voltage drop between Darlaston and the power station of 13·4 volts. He considered that the test on concrete, given in the paper, was hardly a commercial one, as a standard mixture was taken, whereas the mixture used by the ordinary man was more impure.

Mr. Cunliffe said that in Manchester the maximum difference between any two points on the system was 2 volts, and between pipes and rails ½ volt. He considered that the failure of insulator bolts on an overhead system was due to the water becoming an electrolyte and forming rust.

Prof. Schwartz remarked that engineers were apt to disregard as trifles actions which proceeded without noise and with extreme slowness; but the late Sir Frederick Bramwell strongly insisted on the importance in engineering matters of "the next to nothing." With regard to the corrosion of ferro-concrete, he found that coke-breeze concrete was not protective, but that neat cement was very efficient in this respect, and he suggested that the ironwork, before being embedded in the concrete, should be washed over with cement. Cast-iron pipes dipped hot in Dr. Angus Smith's composition were practically immune from corrosion. In the St. Pancras system, with which he was connected some years ago, a number of explosions occurred in the bare copper mains in brick and concrete culverts, and in every case the explosion was found to be due to the presence of coal gas in the culverts. A number of explosions took place in the arc lamp columns in the Euston Road, which were traced to an accumulation of gas in the interior of the column, fired by the red-hot mushroom heads detached from the carbons, which gained access to the column through a brass guide-tube attached to the

globe. A short time ago, in conjunction with Mr. W. Grant, he worked out from from figures kindly supplied by Mr. Lackie, of Glasgow, the resistance in a given case of the return path through the lead sheath of a cable and through the earth, the resistance in the latter case being measured between earth plates, and he found that the earth resistance was considerably smaller, so that electrolysis was possible in spite of the bonding.

Prof. Gee, in reply, said that with respect to his remarks on commercial concrete, his first experiments were made with commercial materials, and such inconsistent results were obtained that he thought he had better employ standard cement and standard sand. The subject (which was in the course of investigation) related to the resistance of porous materials especially in connection with electrical endosmose. Many phenomena depended on current density. The strength of the current, of course, depended on the voltage, but after the voltage of decomposition had been exceeded passive phenomena might be produced at various current densities. The laws of reaction velocity could be deduced from mass action, but the rate of the solution of metals as connected with electrical constants was not yet clear.

LEGAL.

Enforcing an Award.

In the Brompton County Court on April 13th an award given by an arbiter in an action to recover an amount for work done came up before his Honour Judge Selfe. It appeared that certain alterations were in 1905 being made at Euston Hall for the Duke of Grafton, and Mr. Henley, who was the contractor, sublet the electric installation to Mr. Dewhurst. There was no provision or clause in the specifications that the work was to be inspected by a clerk of works or an architect. When the whole was completed it was certified and paid for. It was stipulated, however, that the electric bells, and, indeed, the whole installation, was to be of the "best quality." The work was completed in January, 1906, and in July following when tested it was found to be inefficient. The consequence was that Mr. Heath was called in to do the repairs, and he put the installation right, and it was now pleaded that Heath was entitled to charge Henley for the whole work. Proceedings having been begun in the County Court, the question at issue was referred to an arbiter, who, after a five days' trial, found for Henley. It was contended on behalf of Heath that the arbiter had given his decision on a deficiency of evidence, but his Honour upheld the award, and gave costs on the higher scale.

BUSINESS NOTES.

Curtis Turbine Set for Teesbridge Iron Co.—The British Thomson-Houston Co. have received an order from the Tyneside Electrical Development Co. for an exhaust steam turbine having an output of 1,500 K.V.A. at 2,875 volts, 40 cycles, when running at a speed of 2,400 R.P.M. The turbine will be a standard Curtis type, containing two stages, direct-coupled to a three-phase 40-cycle alternator. The steam for this turbine will be supplied from the works of the Teesbridge Iron Co. at atmospheric pressure, and will be condensed by surface condensing plant of the Mirrlees Watson Co. The condensed steam will be returned to the Teesbridge Co. Provision has been made, so that should the turbine not be running at any time it can be isolated from the condensing plant, and the condensed steam still utilised for the boiler feed of the Teesbridge Iron Co. The turbine and the generator will be capable of an overload of 1,800 K.V.A. The plant had been so arranged that the necessity for the usual foundations are avoided, the condenser being on the same floor level as the turbine itself. The air and circulating pumps will be driven by three-phase, 440 volts, 40-cycle B.T.-H. motors. The sluice valve between the condensing plant and the turbine will also be motor-operated.

Birmingham Sale.—The Birmingham Corporation has accepted the tender of Mr. E. J. Jennings, of Newcastle-on-Tyne, for the purchase of the whole of the generating sets, D.C. transformers, balancers, &c., which until recently formed its generating plant at the Dale End Station.

Colliery Plant.—Messrs. R. H. Longbotham & Co., Ltd., of Wakefield, have received an order for a screen for a South Yorkshire colliery, also for tub-decking gear and cages for another colliery in the same district, and also a third repeat order for a 280-B.H.P. main and tail haulage gear with drums 9 ft. diameter, for a large colliery in the North.

Auction Sale.—Messrs. Battersby & Co. were yesterday, and will be to-day, engaged in holding the last and most important sale of electrical plant and fittings of the Irish International Exhibition. Full particulars appear among our advertisements to-day.

Electrical Trade with India.—A Blue Book was recently issued giving numerous tables relating to the trade of British India with British possessions and foreign countries, between the years 1902-3 and 1906-7. The tables are an abstract of the annual statement of the trade and navigation of British India with foreign countries for 1906-7, which is issued in India in two volumes, and the values are expressed in pounds at the rate of 15 rupees to £1, this rate having been maintained since the beginning of 1898 with but slight variation. It appears that electrical machinery was not separately enumerated until April, 1905, and the statistics in respect of this branch are consequently now given for the first time for two complete financial years. It is shown that the total value of the imports of electrical machinery amounted to £180,272 in 1906-7 as compared with £158,554 in 1905-6; that of steam engines and parts, £829,534 and £654,506, and that of mining machinery £41,410 and £49,727 in the two years respectively. The imports of electrical instruments, apparatus and appliances reached £371,859 in 1906-7, as contrasted with £205,734 in the preceding years, these figures also being published for the first time separately; and those of materials for the construction of telegraphs amounted to £9,898 and £24 in the two years respectively, these being exclusively procured from the United Kingdom. A few details as to the source of the imports in the past two years are given below:—

Electrical Machinery.—	1905-6.	1906-7.
From United Kingdom	£143,177	£154,265
„ Belgium	3,416	6,009
„ Germany	3,779	6,216
„ United States	7,448	8,733
„ Other countries	734	5,049
Total	£158,554	£180,272

Electrical Instruments, Apparatus, &c.—		
From United Kingdom	£183,178	£296,612
„ Belgium	7,750	16,934
„ Germany	7,949	28,059
„ United States	4,383	27,782
„ Other countries	2,474	2,472
Total	£205,734	£371,859

Scientific and Philosophical Instruments, &c.—		
From United Kingdom	£126,331	£85,083
„ Austria-Hungary	703	403
„ Belgium	5,703	3,058
„ France	2,262	1,531
„ Germany	11,513	11,716
„ United States	5,257	3,612
„ Other countries	975	2,222
Total	£152,744	£107,625

Steam Engines other than Locomotives.—		
From United Kingdom	£617,059	£805,136
„ Belgium	4,797	8,748
„ Germany	10,401	1,151
„ United States	13,659	8,227
„ Ceylon	4,284	3,553
„ Straits Settlements	2,611	289
„ Other countries	1,695	2,430
Total	£654,506	£829,534

The imports of tramway rolling stock into India are apparently contained under the heading of railway plant and rolling stock and are therefore not specifically enumerated. Under this heading are included carriages and trucks and parts thereof of the total value of £1,010,275 in 1906-7, as against £263,063 in the previous year. The United Kingdom participated to the extent of £965,702 in the former total, as compared with £251,731 in 1905-6, whilst Belgium was responsible for most of the remainder of the trade in each year.

It is necessary to mention that the statistics already given do not include the quantity and value of the imports of Government stores into British India, these being recorded independently. Thus, the purchases of telegraph materials for Government account in 1906-7 reached £186,072, as contrasted with £91,290 in the preceding year; and out of these totals the United Kingdom supplied £185,791 and £91,188 in the two years respectively. The imports of instruments and apparatus amounted to £94,321 in 1906-7, as against £115,912 in the previous year, and in these cases also, the Government procured practically the whole from the United Kingdom. The Blue Book concludes with a short appendix, giving the special and general duties which are charged on imports into India at the present time.

No-Volt Release for A.C. Motors.—With regard to the recent controversy with respect to the provision of no-volt release adjustments to polyphase motor switches, the Union Electric Co., Ltd., inform us that they have had considerable experience in this direction, especially in connection with high-tension switches; they have now so far standardised these that they can supply as a thoroughly tested and commercial article a form of starting gear for two and three-phase motors fitted with no-volt release. Full particulars of the apparatus in question were included in their catalogue No. 67, which was issued last autumn.

Porcelain Ware Syndicate in Germany.—An association or syndicate of manufacturers of porcelain ware for electrotechnical purposes has been formed, with headquarters in Berlin. It comprises almost without exception all the factories engaged in this particular branch both in Germany and Austria, and it aims at securing an improvement in prices. The latter will be raised shortly in so far as it concerns the articles which have been included within the scope of the syndicate. As the electrical engineering firms are the principal customers for the products, it is considered that the advances in prices will only be successfully carried out if they are kept within moderate limits. If, however, the prices are sought to be substantially increased, it is not improbable that the large electrical firms may embark upon the production of porcelain ware on their own account.

Contract Conditions in Austria-Hungary.—It is announced from Vienna that the 15 largest electrical engineering firms in Austria-Hungary have arrived at an agreement establishing a uniform regulation of conditions of delivery and guarantee in regard to contracts or orders. The arrangement, which came into operation on April 15th, and is indeterminable until the end of 1909, does not in any way affect the prices of electrical manufactures. Among the firms participating are the Siemens-Schuckert Works of Vienna and Buda-Pesth, the Ganz Electricity Companies of the same two cities, the Union Co., of Vienna, the Union Co., of Buda-Pesth, the United Electricity Co. of the same two cities, the Weizer Electricity Works of Graz, Kolben Co., of Prague, and the firm of Krizik, of Prague. It is stated that the conditions agreed upon correspond in substance with those prevailing among electrical firms in Germany.

Platinum Plate.—A useful novelty called "platinum plate" is being placed on the market by Mr. J. Wetzler, of 13, Southampton Street, W.C. This plate is perfectly bright, and is intended to take the place of pure platinum, for which it is adapted in every way. The platinum plating can be made as thick as desired, and the deposit can be made upon any metal; it can be furnished to exact specification as to thickness of platinum and thickness of the metal upon which it is deposited, so that the product is adapted for all purposes for which solid platinum is now used. The economy effected by the use of this platinum plate is obvious, as the plated metal can be furnished at a small fraction of the cost of solid platinum, and in view of the excessive cost of the latter nowadays, we have no doubt that the new device will receive a hearty welcome.

Creditors' Meetings.—Eric Rivers Smith, electrical engineer, 13a, Heath Street, Hampstead.—A meeting of the creditors interested in this matter was held on 16th inst., when a statement of affairs was presented, which showed liabilities amounting to £1,316, made up of the claims of trade creditors £816, and cash creditors £500. The assets totalled £712. After some discussion it was resolved to accept a composition of 10s. in the £ in cash. The following are creditors:—

Electrical Fittings Co.	£124
Armorduct Manufacturing Co.	118
General Electric Co., Ltd.	84
Edison & Swan, Ltd.	60
H. Gardner & Son	55
Farringdon Engineering Co.	35
J. H. Tucker & Co.	31
Pope's Electric Lamp Co.	26
Rose Bros.	25
Bonnella Bros.	25
H. A. Jackson & Co.	23
London Electrical Fittings Co.	22
C. Newson	22
British Prometheus Co., Ltd.	18
Sterling Telephone & Electric Co.	12
Crypto Electrical Co.	11
E. Goossens, Pope & Co.	10
Perfecta Seamless Tube Co.	10

(And a number of others below £10)

Cash Creditors.

T. Gurney, Randall & Sons	£400
F. C. Blackstone	100

Zobel & Sons, electrical engineers, 153, Euston Road, London, N.W.—The creditors were called together a few days ago, when a statement of affairs was submitted, showing liabilities to the extent of £1,990. Of this amount £840 was due to trade creditors, the balance of £1,150 being in respect of cash claims. After allowing £60 for preferential claims the assets were expected to produce £627, a deficiency of £1,363 being thus disclosed. The assets were as follows:—Book debts, £55, expected to realise £25; stock, £659; cash in hand, £3 2s. The household furniture was claimed by the debtor's wife, and a life policy on the debtor's life for £1,000 was mortgaged to the company for £269, and it was not anticipated to be of any further value. Mrs. Zobel, the debtor's wife, and his son, appeared as cash creditors for £1,150. It was reported that the business—an old-established one—was only recently acquired by the debtor, and he had little or no knowledge of the trade. Some time ago his wife came into some money, and this appears to have been put into the business, and been used for the purpose of paying creditors. The debtor had not been able to make the business pay, and he was said to seem desirous of giving it up. He was unable to make any offer of a compromise, and it was pointed out that under the circumstances there was no alternative but to deal with the estate under a deed of assignment or in bankruptcy. It was stated that the cash creditors would be prepared to postpone their claims in favour of the trade creditors. The matter was shortly discussed, and it was eventually agreed that the matter should be dealt with under a deed of assignment with Mr. Hutton, of Messrs. Hutton & Wood, Basinghall Street, E.C., as trustee. The following committee was also appointed:—Messrs. Chance Bros. & Co., French Wreath Co., and Mr. G. G. Poppleton.

Dissolutions and Liquidations.—D. Santoni & Co. (1906), Ltd.—Mr. H. Gordon Nordaby, 13 and 14, Abchurch Lane, E.C., the receiver for the debenture-holders, publishes a notice stating that, he having disposed of the business of this company, any creditors, &c., having debts or claims, &c., against the company must send particulars to him by June 1st.

Brazilian Rubber Plantations and Estates, Ltd.—By an order of the Court the following persons have been appointed a committee of inspection to act with Mr. H. de Vaux Brougham, the liquidator:—G. McLean, 10, Trump Street, Cheapside; W. Roberts, Hotel Victoria, S.W.; and T. Pratt Ling, Brakendale, Dorking, Surrey.

Leeds Copper Works, Ltd.—This company is winding up voluntarily, with Messrs. G. P. Norton, Huddersfield, and J. Marshall, Sunderland, as liquidators.

Siemens Electric Appliances, Ltd.—A meeting is to be held at 12, Queen Anne's Gate, S.W., on May 20th, to hear an account of the winding up from Mr. A. M. Hicks, liquidator.

Mica Boiler Covering Co., Ltd.—A petition for winding up this company is to be heard on April 29th. It is presented by J. W. Morley, commercial agent, of Newcastle-upon-Tyne.

Bankruptcy Proceedings.—Henry Wainwright, electrical engineer, 19, Farrar Street, Barnsley.—A first and final dividend of 9s. 7d. in the £ is payable on April 23rd at the Official Receiver's office, 6, Bond Street, Wakefield.

Catalogues and Lists.—Messrs. Boulton & Paul, Ltd., Norwich.—Illustrated catalogue of "Norvic" steel boats, motor launches, marine motors, paraffin engines, &c.

Carron Co., Carron, N.B.—Small pamphlet giving illustrations, particulars and prices of their electric radiators and electric hot closets.

Messrs. Wellman, Seaver & Head, Ltd., 47, Victoria Street, S.W.—Catalogue consisting of a number of lists concerning their electric motor control apparatus, showing the "Dinkey" controllers of different types for heavy mill work, for heavy work in confined spaces, for ordinary and light crane work; also describing the "Dinkey" motor starter, and the Wellman brake for electrically-operated machinery. Line dimensional drawings, half-tone views, price particulars and brief specifications are given. This catalogue is also issued in French, from the firm's Paris office (14 rue Auber). The "Dinkey" controller was designed some 15 years ago by the chief engineer of the Carnegie Steel Works, to meet the heavy requirements of steel works' machinery, and we understand that it has had an uninterrupted success during that time. Messrs. Wellman, Seaver secured the patents when they purchased the English rights, and have used the controller continually for the last 10 years on all the heavy machines manufactured by them in this country, the result being, we are informed, that some two years ago a demand arose from engineers generally, which led the firm to manufacture the controller in this country, and put it on the market generally.

The British Thomson-Houston Co., Ltd., Rugby.—Pamphlet No. 207, describing their enclosed arc lamps, their construction, &c., and giving a number of views of interiors and exteriors for the lighting of which they are in service.

Messrs. J. C. Fuller & Son, Woodland Works, Bow, E.—New catalogue (32 pages), in which they give illustrations, prices and brief particulars, of a great variety of Fuller ignition accumulators, coils, magnetos, charging equipments, dry batteries, lamps, &c., for motorists and the motor trades. Copies of the catalogue will be sent on application.

Messrs. J. W. Brooke & Co., Ltd., Adrian Works, Lowestoft.—Twenty-page catalogue of their motor-boats, with a long list of users, and a number of neat views showing boats of different sizes for several classes of service. Prices are stated. An accompanying catalogue gives descriptive and illustrated information, with a number of separate line drawings, relating to the Brooke marine motors.

Maschinenfabrik Oerlikon, Oswaldestre House, Norfolk Street, London, W.C.—Publication No. 45, giving information in French relating to, also a half-tone view of, their electrically equipped fire engines. A second pamphlet of some 36 pages contains an admirably illustrated account of the Locarno-Pontebrolla-Bignasco single-phase railway, the second built and equipped in Switzerland by the Oerlikon Co.

Messrs. Tangyes, Ltd., Birmingham.—No. 108 catalogue of machine tools, containing a large number of fine illustrations of their various manufactures of this class, including electrically-driven examples. The list is divided up by finger index into sections dealing respectively with lathes, drills and borers, planers, shapers and slotters, millers, punchers and shears, screwers, wood-working machinery, shaftings and bearings, small tools and sundries.

The Electrical Power Storage Co., Ltd., 4, Great Winchester Street, E.C.—New catalogue consisting of a number of lists in expanding binder, giving with admirable clearness a large amount of tabulated information concerning their various types of E.P.S. batteries for all classes of service, central station, traction, ship lighting, laboratory, moting cells for car and launch use, and so forth. Dimensional diagrams are given. Some miners' electric safety lamps are included, also railway signalling and photographic lamps, and test instruments. A convenient finger index divides the book into sections for easy reference.

Messrs. Falk, Stadelmann & Co., Ltd., 83, 85 and 87,

Farringdon Road, London, E.C.—List illustrating and describing and stating prices of a newly introduced series of adjustable standards for electric light. The standards are constructed with telescopic tubes and universal joints which admit of a large measure of adjustability. It is claimed that the principle of the spring-controlled joints with which the standards are provided obviates the employment of thumb screws, an obvious advantage. Certain types are stated to be particularly suitable for optical and dental use, office service, draftsmen's tables, engraving and half-tone work, &c.

The Mercantile Engineering Co., 71, Market Street, Manchester.—Leaflet showing Mills's "Twin Spring" anti-vibrator, a simple device for suspending metallic filament lamps so as to prevent breakage by shock. Several sizes are made to suit different requirements, and the hooks are insulated.

Messrs. Kelvin & James White, Ltd., Cambridge Street, Glasgow.—Pamphlet No. 5, dealing with the latest (1908) patterns of Lord Kelvin's multicellular electrostatic voltmeters.

Book Notices.—The first number of the *Post Office Electrical Engineers' Journal* has been issued by the publishers (H. Alabaster, Gatehouse & Co., 4, Ludgate Hill, E.C. 1s. net). It is a quarterly publication very much after the style of *Science Abstracts* in appearance and in size, and is the organ of the Institution of Post Office Electrical Engineers, though it is wider than the latter in its appeal, its object being to interest not only the members of that Institution, and all Post Office officials of the United Kingdom connected with telegraphy and telephony, but all engineers in other service who are interested in these subjects, and last, but not least, Colonial engineers. The first number (April) contains some words of welcome from the late Chief, Sir John Gavey, and a certain amount of institution, social, personal, and other like news, but technical articles relating to telegraph and telephone engineering, and wireless, matters are rightly preponderant. Sir John Gavey, in his opening message, refers to the difficulty of the professional man wading through the English and Foreign literature in order to keep abreast of the most modern views, and he apparently holds out the hope that in the new journal the telephone and telegraph engineer will find all that they want. Time will soon show whether that can be reasonably anticipated; perhaps some may find that the new publication makes one more that will have to be waded through (though only four times a year) in addition to others, not instead of them. This seems to be the more probable when we see it stated that the *Journal* is to be an incentive to authorship, thus adding to the literature of these subjects instead of substituting a compressed tabloid of what appears in other journals. The more practical men we can get to set down their ideas on paper, the better will it be for the advancement of the subjects dealt with, and the more efficient may be expected to become the general body of readers in their various avocations; but we are afraid that the time of the student and engineer are not saved by the multiplication of new journals. These comments are, however, merely by the way, and we extend to the *Post Office Electrical Engineers' Journal* a hearty welcome, and wish it every success.

"Proceedings of the American Society of Mechanical Engineers," March, 1908. Vol. 30, No. 3. New York: From the Society. $1.00 per copy.

"Magnetism and Electricity." By S. S. Richardson. London: Blackie & Son, Ltd. 1908. Price 5s. net.

"On the Light thrown by Recent Investigations on Electricity on the Relation between Matter and Ether." By J. J. Thomson, D.Sc., F.R.S. Manchester: The University Press. 1908. Price 6d. net.

"Development and Electrical Distribution of Water Power." By L. Lyndon. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. 1908. 12s. 6d. net.

"Telegraphic Systems." By A. Crotch. London: C. Griffin and Co., Ltd. 1908. Price 5s. net.

Veritys, Ltd.—Following upon our notice of some months ago regarding the extensions made to Messrs. Veritys' works at Aston, we learn that the new works, as well as the old, are already well filled with orders. The firm have sent us a view, showing 36 battleships and cruisers, for which they are manufacturing, or have just completed, electric blowing equipments. We understand that the demand for interpole motors also continues brisk. Messrs. Veritys fit interpoles to all their standard machines down to and including 2 H.P. Arc lamps nowadays are becoming less and less a season's trade, and the shops at Aston are almost as busy now, turning out "Monarcs" and "Aston-Worsleys" as they were in the autumn. The art fittings department, as a result of the firm's new designs recently issued, is full of orders, and altogether the Plume and Victoria Works of Messrs. Veritys, Ltd., appear just now to be very actively employed.

LIGHTING and POWER NOTES.

Aberdare.—The U.D.C. has decided to engage an expert to report on the E.L. question. By 8 votes to 7, the Council has decided not to oppose the Bill of the South Wales Electric Power Distribution Co.

Bermuda.—Mail news from Hamilton, Bermuda, states that an interesting law case has just been amicably settled there. Action was being taken against the Bermuda Electric Light Co. by the owner of a building which, it was alleged, was shaken by the vibration of the working plant. The owner applied for an injunction restraining the company from operating the plant. The settlement was that the plant should not be operated after 9 o'clock p.m. pending the transfer of the plant to a new power house which is being built.

Bispham.—The B. of T. has granted a prov. order for E.L. to the U.D.C. This gives the Council power to generate its own energy or to take a supply in bulk, and the maximum charge is fixed at 8d. per unit. The Board advises that, if possible, a supply in bulk should be taken from the Blackpool and Fleetwood Tramway Co.

Blackpool.—The L.G.B. has held an inquiry into an application of the Corporation to borrow £5,000 for the purpose of extending the electricity mains. The town clerk pointed out that there were now 1,250 consumers, and that the capital expended amounted to £200,000.

Bournemouth.—A double electric passenger lift was opened on the 16th inst. on the East Cliff. The vertical rise is some 100 ft.; Messrs. Waygoods supplied the plant.

Brighton.—The T.C. has adopted the following revised charges for electricity:—Within the borough—Lighting: Hotels, churches, &c., 3d. per unit; shops, private houses, &c., 4d.; arc lamps, 3d.; supply by prepayment meter, ½d. per unit in addition to above rates in lieu of meter rental. Consumers of over 20,000 units per annum will be supplied on the following terms:—Hotels, &c., up to 10,000 units per annum, 4d. per unit; from 10,000 to 20,000, 3d.; from 20,000 to 40,000, 2d.; beyond, 1d.; other premises, up to 20,000 units per annum, 4d.; from 20,000 to 30,000, 3d.; beyond, 2½d. Power, heating and cooking: Through separate meter without restriction as to time, 1½d. per unit; through separate meter and time switch, cutting off supply between 5.30 p.m. and 8 p.m. during January and December, 1d. per unit. Electricity on maximum demand system, 6d. and 2d. Outside the borough—Lighting, 4½d. per unit. Power, heating and cooking, 2d. More than half the Brighton consumers have changed over to the flat-rate system of charging.

Continental Notes.—Germany.—Plans are being prepared in respect of a projected joint central electric lighting station for the towns of Minden and Herford at an estimated cost of £73,450.

Italy.—Our contemporary, *Electricity* (of Milan), for April 2nd announces the inauguration of the hydro-electrical installation at Cervino, due to the initiative of the Electrical Society of Valbormida. It is intended to provide from the central works, electrical energy for lighting and power in all the villages of the Bormida Valley between Acqui and Alexandria, and in the near future transmission lines will be taken to Gamalero and Orsara Bormida.

A large hydro-electrical installation has recently been completed in Upper Piedmont, which will supply energy in the Padana Valley on the Plain of Lombardy. It is worked from the Anza Canal, a torrent from Monte Rosa. The canal has been taken along the west side of the mountain through two tunnels, one of 500 and the other of 400 metres length.

Dundee.—It has been agreed to light the Art Galleries with electricity to be supplied by the Corporation. It is estimated the annual saving will amount to £100.

Dunfermline.—The electric lighting problem has been again discussed by the T.C. Provost McBeth moved that the proposals of Messrs. Gibbings & Chauntler, who offered to carry out a lighting scheme, be submitted to the Council before being sent to Sir Alex. Kennedy for his opinion; this was agreed to.

East Ham.—The Electric Lighting and Tramways Committee has decided to accept the following tender of Mr. W. R. Reynolds for fixing and supplying the necessary installation (exclusive of lamps) in connection with the hiring of arc lamps by consumers:—For two-lamp installation, £2 17s. 6d.; for four-lamp installation, £5 15s.; for six-lamp installation, £8 12s. 6d.

Exeter.—The Electrical Committee is to recommend a reduction of 10 per cent. in the lighting charges as from July 1st next. The price per unit will then be reduced from 5d. to 4½d. Large power consumers are to have a reduced scale of charges, ranging from 2½d. to 1½d. per unit, according to quantity used.

Halesowen.—The B. of T. has informed the U.D.C. that a prov. order for E.L. has been granted to Mr. Geo. Balfour, of London.

Kingston-on-Thames.—In consequence of representations made to the T.C. by the Board of Education as to insufficient air space in the Kingston schools, it is proposed to install electrically-driven ventilating fans, and thus to obviate the requirement as to 10 ft. of space per pupil.

Kingussie.—The T.C. has agreed to leave the question of electric lighting, at an estimated cost of £3,000, over for a time.

Llandudno.—The B. of T. has amended the draft of the provisional order which the Llandudno Pier Co. is seeking to obtain in Parliament, by deleting Clause 15, which gave powers to the company to generate and supply electrical energy.

London.—Poplar.—In regard to the B.C.'s provisional approval of electricity extensions at an approximate cost of £27,209, application is to be made to the L.C.C. for a loan

of not exceeding £24,000, subject to the B.C. subsequently resolving to carry the scheme into effect and to revision of the amount of the loan in accordance with tenders which may be accepted. The estimated amounts chargeable to capital account are:—Millwall substation: land and buildings, £800; mains, £5,552; machinery, £16,560; house connections, £250; meters, £250; contingencies, £365. The expenditure chargeable to revenue account is £3,432; to this sum has to be added £1,400, cost of a displaced set, less the amount to be realised by its sale, which it is proposed should be fixed at a minimum of £700, making a total of £4,132 to be written off the amount of the existing working balance and the current year's profit.

Southwark.—The London Electric Supply Corporation, Ltd., intends to lay low tension distributing mains, consisting of concentric lead-covered cables drawn into cast-iron pipes and working at a pressure of 460 volts (continuous current) in Great Dover Street, and also to construct inspection boxes of the usual type and pattern. The B.C. Works Committee has decided that no objection be offered to the proposals, subject to conditions. Having received an undertaking from the L.C.C. that a clause sufficient to cover the interest of the B.C. shall be inserted in the present year's Bill, and that provisions for the revival of the powers of the Council with regard to the subways at the Elephant Headway shall be inserted in the General Powers Bill next session, the General Purposes, Law and Parliamentary Committee has decided that the petition of the Council against the L.C.C. (Tramways and Improvements) Bill be withdrawn.

Newport (Mon.).—The T.C. has decided to oppose the Bill of the South Wales Electrical Power Distribution Co., which seeks to give the company power to supply energy within the borough.

Rochdale.—The electricity department's income for the year was £20,378, an increase of £3,092. Expenses were £11,014, an advance of £2,552. Gross profits £9,364, against £8,824. There is a surplus of £4,299, and £2,000 will be devoted to the relief of the rates.

Shirebrook.—The Shirebrook Colliery Co. has agreed to accept the Council's offer of 35s. per lamp for the supply of electricity for E.L. at the Model Village.

Wednesbury.—The T.C. has received from the L.G.B. sanction to a loan of £8,000 for the provision of E.L. plant.

Weston-super-Mare.—The U.D.C. has granted permission for the electric supply company to make experiments for lighting the sea front by electricity.

Yardley.—It is reported that the negotiations between the Council and B.E.T. Co., in regard to purchasing the company's generating plant at South Yardley power station, to form the nucleus of the Council's E.L. undertaking, are practically concluded. The Council would have to remove the plant to a new building of its own.

Yeovil.—The B. of T. has revoked the Corporation 1903 Electric Lighting Order.

York.—A L.G.B. inquiry was held last week into the application of the T.C. for a loan of £25,285 for E.L. purposes. The inquiry was adjourned for accounts to be prepared showing exactly the financial position of the undertaking.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—The burgh surveyor reports that the track in Great Northern Road requires to be anchored. The estimated cost of carrying out the work is £5,365, and before deciding on the matter, the Committee resolved to inspect the track.

Bradford.—A deputation of the Tramways Committee recently visited Leeds and Sheffield (and previously, Manchester and Liverpool) to note their practice with respect to the construction and renewal of the permanent way, in view of the considerable amount of money which the Corporation intends to spend in this direction.

Chester.—During the past year the tramways traffic revenue has been £11,844; and the total number of passengers carried, 2,952,616. The working expenses for the year amounted to £7,660, and the balance carried to net revenue account to £4,583. The surplus on the year's working is £448.

Continental Notes.—Germany.—An important decision has just been arrived at in Berlin in regard to the competitive powers of the Grand Tramway Co., the Elevated and Underground Electric Railway Co., and the projected municipal North-South and Kreuzberg-Wedding electric railways. The tramway company, which has a monopoly of tramway traffic and operates over 300 miles of track, which were converted to electric traction mainly on the overhead trolley system in recent years, holds it concession by virtue of agreements concluded with the municipal authorities, and the powers exercised by the railway company over its few miles of track were also granted by the city authorities. Although the tramway company possesses such an extensive network on the street surface, it has regarded with some apprehension any authorised or probable extensions of the railway company's system which, when not of the high level kind, is of the shallow underground type. In the circumstances, the tramway company's grievance had to be directly raised against the municipal authorities, this body having granted powers both to the tramway and to the railway company, and against the authorities as the promoters of an undertaking to compete with the tramways on certain routes. In fact, the case, from the legal point of view, solely lay between the tramway company and the city authorities. Eventually the dispute was referred to arbitration, and the Court, whose award was made on April 16th, rejected the tramway company's claim for compensation in so far as it refers to the extension of the railway company's underground line from the Spittelmarkt to the Schönhauser Allee, whilst it held that the company is entitled to be indemnified by the city authorities in the case of the construction of the North-South and Kreuzberg-Wedding underground lines. It was estimated by the tramway company that an annual loss of £100,000 would be incurred by the before-mentioned prolongations of the existing electric railway. The amount of compensation to be paid by the city authorities in respect of the contemplated municipal railways will have to be determined by a second arbitration, but in the event of the sum being sufficiently large to place a financial burden on the lines, it is probable that the latter will not be constructed. The present award of the Court of Arbitration does not allow of any appeal, and it will therefore be possible for the railway company to accelerate its works so that the line from the Spittlemarkt to the Alexander Platz will be completed by the end of 1912 at the latest, and to the Schönhauser Allee by the year 1915.

France.—New electric tramways have just been opened between Lille and Leers and between Roubaix and Hem.

Portugal.—A tramcar and an omnibus collided at Lisbon on the 19th inst.; 29 persons were injured, and several of them are not expected to recover.

East Ham.—At a special meeting of the T.C. a letter was received from the Ilford U.D.C., stating that it did not deem it desirable to make any alteration in the existing arrangements for the running of the cars, and in view of the probability of a conference being arranged between West Ham and Ilford, is unable to consider the question of inter-running from the Manor Park Broadway to Seven Kings at present. The T.C. has decided to purchase from the North Metropolitan Tramways Co., subject to the consent of the B. of T., all portions of the Romford Road lines belonging to the company (exclusive of depôt and all rolling stock) and situate within the borough, and constructed under the North Metropolitan Tramways Act, 1884, at the sum agreed upon between the Council and the company, viz., £8,000.

Handsworth.—Application has been made to the B. of T. for the appointment of a referee to settle the price to be paid by the Council for the part of the company's undertaking authorised by the Birmingham Central Tramways (Extension) Order, 1886, within Handsworth; and also the terms of the lease to be granted by the Council to the company, should no other arrangements be made. The Committee recommends the Council to renew its consent to the use of cable traction on the tramways in Soho Hill, Soho Road and Holyhead Road for six months.

Haslingden.—It was recently reported to the Electricity Committee that arrangements had been completed for the through running of electric cars from Accrington to Rawtenstall, the two extreme points of the old tramways system, after negotiations between the three boroughs concerned. It has been decided that arrangements shall be made for Accrington to run its electric cars to Haslingden immediately the track, standards and overhead equipment are ready—this as a temporary measure until Haslingden is able to obtain energy from the generating station about to be erected in that locality. It is not expected that this station will be ready for at least nine months.

Heywood.—It is expected that the working of the tramways for the past year will show a loss when the accounts are fully made up; but on the electricity works there may be a profit.

Ilford.—At the last meeting of the U.D.C. a letter was received from the Board of Trade inquiring if the Council would attend a conference with the Barking authority on the subject of the inter-running of the tramways, to be presided over by a chairman appointed by the B. of T. It was resolved that the conference be attended.

Leyton.—Through a breakdown at the power station, the Council's nine miles of tramways were brought to a standstill on the evening of Good Friday, greatly inconveniencing thousands of trippers at Epping Forest.

London.—At the last meeting of the L.C.C. it was decided to acquire the Highgate cable tramways for the sum of £13,000. The total ultimate expenditure on capital account in connection with the reconstruction of the lines on the conduit system is estimated at £53,200. If the overhead system were adopted this total would be reduced by £6,045. The question of entering into an arrangement with the Metropolitan Electric Tramways Co. was considered at the same meeting. Particulars of the proposal were given in this journal on April 10th. After discussion, the Council referred back to the Parliamentary Committee the recommendation submitted in respect of the suggested scheme. An estimate of £34,700 was approved for the establishment of the overhead system on tramways from Hammersmith Broadway to Putney, subject to the consent of Parliament to the adoption of this particular method.

A serious collision occurred on 16th inst. between a runaway car and a stationary one on the L.C.C. Brixton Hill route. According to the daily Press, the driver of the runaway car was unable to operate his hand-brake, and his attempt to apply the electro-magnetic track brake was frustrated by the burning-out of a coil. No serious injury resulted to passengers, but the cars were disabled, and this delayed the traffic.

Manchester.—The estimates of the Corporation Tramways Committee for the coming year have been prepared, and will be submitted to the City Council at its next meeting. The Committee anticipates an income of no less than £813,662, as compared with £769,188 (approximate) received this year, and expects to be able to hand over £60,000 to the city fund in relief of rates. This is £5,000 more than was handed over last year, and is in addition to £4,100 for interest and sinking-fund charges in connection with the widening of the streets around the Royal Infirmary secured by the purchase of the infirmary site.

Last year the Committee estimated for no profits from the parcels department, but the department has actually produced an income of £1,240, and the Committee expects to receive £1,500 from the working of the department next year.

Capital expenditure for next year on new cars, sheds, &c., is estimated at £78,000, as against £44,453 spent last year.

Morecambe.—The electrified section of the Midland Railway between Morecambe and Heysham Harbour has been opened to the general public, and the new service attracts a large number of passengers. The electrification is on the single-phase system, and is the first of its kind to be brought into practical use on any English railway system.

Rochdale.—The gross receipts of the Corporation tramways for the past 12 months amount to £56,557, an increase of £2,000 on the preceding year. The working expenses rose from £29,505 to £33,043. The deficiency on the working for the year is £2,102, which, with £1,946 arrears of sinking fund, gives a total deficiency to be provided out of the rates of £4,048.

Torquay.—The Torbay Road route of the Torquay tramways was opened for public service on Thursday morning. The construction of this section completes the 8½ miles of line for which the tramway company received powers. The new track, which is a double one, is a mile in length.

U.S.A.—Two heavily-laden street cars collided on the Brooklyn tramways on the 21st, one being thrown on to its side and catching fire. Luckily firemen were at hand and succeeded in rescuing the passengers, 16 of whom were more or less injured.

TELEGRAPH and TELEPHONE NOTES.

Austria.—At the end of 1906 the telegraph system aggregated 37,966 km. of State lines; 4,851 km. of railway and 100 of private line, or a total of 42,918 km. The total wire mileage of the three systems was 145,794; 68,828, and 323 km. respectively or a grand total of 214,945 km. The system of State lines and wire increased during the year by 674 and 4,290 km. respectively, that of the railways by 14 and 1,571 km., while the figures for the private systems were 100 and 322 km. The wires are chiefly composed of iron. There were in Austria 6,409 offices open to the public, being an increase of 104 on the previous year; 4,026 were Government and 2,360 railway offices. The number of offices represents one for every 46·8 square km. and 4,080 inhabitants. A pneumatic system is working between Vienna, Prague and Carlsbad, the length being about 81 km. 52,453 free Government telegrams were sent as well as 1,844,471 service telegrams.

The ordinary telegraphic traffic amounted to 16,949,263 telegrams, of which 8,627,331 were inland; 959,432 to and 980,440 from Hungary; 72,556 from Bosnia, and 80,039 to Bosnia, while 2,142,056 were dispatched to, and 2,250,064 were received from, foreign countries. There were also 1,837,345 telegrams in transit. The total represents an increase over last year of 598,743 telegrams.

It is interesting to note the direction of the traffic, in view of the rapid multiplication of telegraph routes. Thus 1,272,863 telegrams were sent to Germany, 1,293,719 were received from there, and 490,241 telegrams passed in transit for that country. The figures for Italy were 167,773, 158,605 and 205,386; for France, 123,493, 140,715 and 99,008; for Great Britain, 115,758, 163,168 and 86,714; for Russia in Europe, 113,101, 128,607 and 76,623; for Switzerland, 80,130, 79,840 and 53,173; for Turkey, 39,827, 36,167 and 64,333; and for Bulgaria, 12,926, 12,746 and 46,527 respectively. There does not appear to be much American traffic, as there were only in all 50,070 messages for North America and 4,697 for South America, while telegrams to China numbered only 3,070. For the year, received telegrams showed an increase of 169,978; transit telegrams 116,361; and telegrams sent, 136,379.

The average length of telegrams was 13·7 words. The pneumatic tube service dealt with 4,170,400 telegrams. Receipts for the year amounted to 13,375,489 fr., as against 12,787,361 in 1905.—*Journal Télégraphique.*

Canada.—The announcement of the purchase by the Alberta Government of the Bell telephone system in the province for £135,000, is officially confirmed.

Brazil.—From a recent communication concerning the commercial development of Brazil, extraordinary progress is noticeable in regard to telegraphic communication. There are at the present time 60,000 km. of telegraph lines, including the coast and river cables; of this the Government owns 27,349 km., with 3,331 stations. Recently a new line of 2,100 km. has been erected between Rio Janeiro and Cuyaba on the River Madeira.

Code Telegraphy.—The London Chamber of Commerce has received from the Postmaster-General a statement on the subject of the possible adoption of restrictive regulations with regard to code telegrams by the approaching International Telegraph Conference. The P.M.G. points out that the privilege of using artificial "pronounceable" words on the footing of code at 10 letters to the word was granted on the assumption that it would not be abused; but, unfortunately, many words had been submitted, such as BYWRGROCBX, which could hardly be said to be pronounceable. A telegraphist could deal more rapidly and surely with a pronounceable word, which he could grasp and remember while transmitting, than with an arbitrary combination of letters, each of which required a separate effort of attention. He, therefore, thought it desirable that the condition as to pronounceability should be more clearly defined, in order to check this growing tendency, without, however, adopting an ungenerous interpretation of the condition.

India.—It appears that the object of the Indian Government in appointing Mr. Newlands to investigate and report upon the telegraph service was to find and remove the cause of the great delays experienced in the transmission of telegrams. While in England 91·7 per cent. of the messages are put on the wires within 10 minutes of their receipt, in India only 8·2 per cent. come within this limit, and no fewer than 57·6 per cent. are delayed over 40 minutes. The delay, according to Mr. Newlands, is mainly due to unnecessary signalling operations, the compiling of useless returns and the inefficient organisation of the hours of work. The new scheme of duties will not only accelerate the dispatch of business, but will also reduce the amount of night work.

As a result of negotiations with the Indian Government, the strike in the telegraph service has come to an end, and the men have returned to work, to carry out a five weeks' trial of the new system of watches. The Government has appointed a special committee to investigate the alleged grievances of the telegraph staff throughout India.

Jamaica.—The Jamaica Press is agitating for a telephone service not merely confined to one or two towns, but one which can be used generally throughout the island, and owned by the public, so that the desire to make a profit will not be the dominant consideration.

Measured-Rate Tariff.—In a letter to the Press recently, Mr. H. Laws Webb pointed out that the French Government had adopted the measured-rate principle in a new Bill authorising expenditure on the reconstruction of the Paris telephone system with central battery plant. This tariff is already in force in French towns of less than 80,000 inhabitants, and it is recommended not only for Paris, but also for all the other large towns.

New Cable.—The new submarine cable between the Cocos Islands and Java is open for traffic.

Royal Engineers.—The *Times* reports that it has been decided to increase the establishment of the Royal Engineer Telegraph Reserve, composed of telegraphists in the Post Office service.

Telegraphic Interruptions and Repairs:—

	Interrupted.	Repaired.
Cables.		
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Closed..	Jan. 13, 1908 .. ..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Alexandra-Larnaca	Jan. 28, 1908 ..	..
Paramaribo-Cayenne	Mar. 15, 1908 ..	April 20.
Landlines.		
Puerto-Barrios	Aug. 2, 1902 ..	..

Wireless Telegraphy.—According to the Berlin *Tageblatt*, the steamer *Kap Frio* when situated to the south of Cape Finisterre, maintained communication with the *Kap Roca* and *Kap Arcona*, at a distance of from 932 to 992 miles. The *Grosser Kurfürst*, belonging to the North German Lloyd Steamship Co., and having the King of Saxony on board, made its presence known by means of its English-made apparatus; it had endeavoured in vain to transmit a telegram concerning the King to Scheveningen or any other Continental station, and finally turned to the *Kap Frio*, which is equipped with the Telefunken system, and which transmitted the message to Scheveningen. Hitherto the majority of the English stations installed on German fast steamers, the Berlin newspaper adds, have declined to enter into communication with stations of other systems, but the presence of the King of Saxony rendered it necessary to abandon this principle in this particular case.

Wireless Telephony.—On Wednesday last week a lecture prepared by Mr. Valdemar Poulsen, on "Telephoning Without Wires," was delivered by Mr. Nevil Maskelyne, on behalf of the author, at the London Institution. Mr. Poulsen reminded the audience of the demonstration in connection with his system of wireless telegraphy, which took place at the Queen's Hall some 17 months ago, and remarked that his reference on that occasion to the possibility of wireless telephony with undamped waves had become an actual fact. He then proceeded to explain the superiority of the undamped train of waves obtained from his modification of the Duddell musical arc over the discontinuous ulses produced by the "spark" system, and stated that with his

system he had been able to telephone without wires over a distance of 270 km., and to transmit music 460 km. Mr. Maskelyne afterwards gave an experimental demonstration of "Tesla" high-frequency phenomena.

CONTRACTS OPEN and CLOSED.

OPEN

Antwerp.—April 30th. Two electric lifts in premises belonging to the municipality in the Place de Meir, Antwerp. Tenders to M. le Bourgmestre de la Ville, Antwerp. Deposit of 1,000 francs (about £40) to qualify. Specification may be obtained from the Hotel de Ville, Antwerp (50 centimes), but a copy may be inspected by British contractors at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Australia.—PERTH.—September 7th. 650 telephone wall sets, 150 table sets, various switchboards, other instruments, protectors, &c., for the Postmaster-General's department. Some particulars can be seen at the ELECTRICAL REVIEW office.

MELBOURNE.—June 9th. Deputy Postmaster-General requires tenders for 2,800 jacks, in strips of 20; 1 mile of 64-wire switchboard cable; 50 three-conductor cords, 7 ft. long; 96 three-part plugs; and 66 listening and ringing keys. Tenders to Deputy Postmaster-General, Melbourne. Commonwealth of Australia offices in London, 72, Victoria Street, S.W. Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C. —*Board of Trade Journal.*

Darlington.—May 11th. One Lancashire boiler and superheater for the Corporation electricity department. See "Official Notices" to-day.

Dundee.—April 27th. Pipe work, pumping plant, and overhead travelling cranes for the Corporation's new generating station. See "Official Notices" April 10th.

Eccles.—April 27th. Lancashire boiler and superheater, and 210-KW. steam engine, alternator and exciter, for the Corporation. See "Official Notices" April 10th.

Gillingham.—April 27th. Coal for the B.C. electricity works. See "Official Notices" April 10th.

Glasgow.—April 27th. Cables and wires, meters, and arc lamp carbons for 12 months, for the Corporation. See "Official Notices" April 17th.

Glasgow.—April 27th. Coal, tubes, troughing, &c., also cast-iron joint-boxes for the electricity department. City electrical engineer.

Govan.—April 27th. Stores for the Corporation electricity department. See "Official Notices" April 10th.

L.C.C.—May 9th and 11th. 175 car-bodies, trucks and equipments; wiring and fitting of Hackney car-shed. See "Official Notices" April 10th.

Poplar.—April 29th. Switchboards and gear for electricity works and sub-stations of the Council. See "Official Notices" March 27th.

Rawtenstall.—May 4th. Steel poles, overhead equipment and accessories, for the Corporation. See "Official Notices" April 17th.

Spain.—The municipal authorities of Sarria (province of Barcelona) have just invited tenders for the concession for the electric lighting of the town during a period of 15 years.

Valparaiso.—May 30th. The Junta Economica de la Dirección del Material of the Navy Department requires tenders for the equipment of the Chilian Navy with electrical instruments, motors, and fittings. Five years' contract.

CLOSED.

Aberdeen.—The Tramway Committee has accepted the offer of Messrs. Milnes, Voss & Co. for six additional top-covers for cars, at £138 each.

Bolton.—The following tenders have been accepted by the Corporation tramways department:—

Walter Scott.—Rails and fishplates.
Hadfields, Ltd.—Tie-bars.

Bradford.—The following tenders for the supply of steel girder rails, &c., have been accepted:—

Bolckow, Vaughan & Co.—1,100 tons of steel girder rails.
James Russell & Sons.—55 steel poles.
Clegg & Howgate, Ltd.—Malleable iron castings, £53 8s. 4d.
J. & T. Clark.—Iron castings.

The offer of Hadfield's Steel Foundry Co., Ltd., for the supply of points and crossings required for use with temporary track, at the price of £162 10s., has been accepted.

Croydon.—The C.C. has accepted the following tenders for electricity works requirements:—

Coal and ash conveyor.—Messrs. Babcock & Wilcox, Ltd., £1,154.
Coal and ash bunkers.—Weber Concrete Construction Co., £681 11s.
Builders' work.—Electricity works, £205 17s.
Switchboard flooring.—St. Pancras Ironworks Co., £144.

The following tenders have been accepted for the supply of coals to the electricity works:—

Large Welsh coal.—Messrs. Cory Bros. & Co. (for three months).
Large hard steam coal.—Messrs. J. H. Gilman & Co. (from May 1st to March 31st next).
Small nut coal.—Messrs. J. H. Gilman & Co. (for six months).

Dundee.—Messrs. G. H. Nicoll & Co. have secured the contracts for electric wiring, heating and ironwork at the Blackness Library (£560).

Glasgow.—The Electricity Committee has accepted the tender of Messrs. Babcock & Wilcox (£12,695) for five additional steam boilers and mechanical stokers at the Port Dundas and St. Andrew's Cross stations. The engineer recently reported that tenders were received for (1) switchboards and instruments, and (2) motor-generators and rotary converters at any of the sub-stations. The acceptance of the following offers was recommended:—

Mechan & Sons.—Low-tension switchboards, £786 (lowest tender).
Ferranti, Ltd.—Extra high-tension switchgear, £750 (lowest offer complying with the specification).
British Westinghouse Electric and Manufacturing Co.—Motor-generators and rotary converters (the lowest offer), to the extent of £7,596 only in the meantime.

The Tramways Committee has accepted the following offers for stores:—

Special track-work.—Lorain Steel Co.
Relays.—Jas. M'Millan & Co.
Gear wheels.—British Westinghouse Co.
Car axles.—Glasgow Railway Engineering Co.
Axles and wheels.—Glasgow Railway Engineering Co.
Steel tires.—Brown, Bayley's Steel Works.
Fuel.—J. Johnstone & Boath, Flemington Coal Co., Wm. Young & Son, Hamilton, M'Culloch & Co., Wm. Baird & Co., Summerlee Iron Co., Jas. Dunlop & Co., and R. Addie & Sons' Collieries, Ltd.
Chilled iron brake blocks and car wheels.—Miller & Co.
Carbon brushes.—Le Carbone.
Iron castings.—R. Howie & Co., J. & A. Law, British Hydraulic Foundry Co.
Malleable iron castings.—Tangyes, Ltd., and Springfield Steel Co.
Steel castings.—Clydesdale Steel and Foundry Co.
India-rubber and asbestos goods.—Geo. M'Lellan & Co., and Clyde Rubber Works, Ltd.
Springs.—Geo. Turton Platts & Co., and Cockburns, Ltd.
Water, gas and steam tubes and fittings.—D. Richmond & Co.
Galvanised wires.—W. T. Glover & Co.
Tool steel.—Ibbotson Bros. & Co., and L. N. Ledingham & Co.
Iron and steel scrap for disposal.—David Smith, Ross, Jenkins & Co.

G.E. Railway.—The Great Eastern Railway Co. have placed an order with the Sandycroft Foundry Co., Ltd., for 10 "Cascade" induction motors for driving printing presses.

Hornsey.—The B.C. last week accepted the following tenders for cables and cable stores, &c.:—

Western Electric Co.—All classes of cable.
Cable Accessories Co., Tipton, and British Insulated & Helsby Cables, Ltd.—Joint-boxes (not including dead-end boxes).
W. Lucy & Co.—Dead-end boxes.
Sutton & Co., Ashby-de-la-Zouch.—Troughs, bends, covers and cable supports.
Thomas Crow & Sons, West Ham.—Pitch compounds.

There were 12 tenders for meters, and those accepted were submitted by the Electrical Co., Ltd.; Ferranti, Ltd.; Reason Manufacturing Co., Ltd.; and Chamberlain & Hookham, Ltd. There were nine tenders for consumers' fuse-boxes, and that of Sykes & Sugden, Ltd., Huddersfield, was accepted. No figures were given.

London.—HAMMERSMITH.—The Electricity and Lighting Committee has decided to accept the tender of the Main Colliery Co. for the supply of Graigola and Victoria coal, at 15s. 10d., for a period of three months, with the option of continuing the contract for a further nine months.

L.C.C.—The Highways Committee of the L.C.C. have accepted the tenders of Hurst, Nelson & Co., at £369 per set, for car furniture in connection with the construction of 50 new car bodies by the tramways department, for 50 sets of sanding gear, movable steps and lifeguards, at £8 2s., £3 12s. and £4 5s. per set respectively, and for 50 sets of window operating gear, at £12 10s. per set. The United Electric Car Co. has secured the contract for 50 sets of brake gear, at £4 19s. per set, and Hoskins & Sewell that

for 50 sets of ventilator operating gear, at £3 per set. The details for car furniture and brake and sanding gear, &c., are as follows:—

Car Furniture, Per Set.

Hurst, Nelson & Co.	(accepted)	£369
Hoskins & Sewell		378
Howarth & Houson		512
Player & Mitchell		516

Brake and Sanding Gear, &c., Per Set.

	Brake gear.	Sanding gear.	Movable steps.	Life-guards.
Hudson & Bowring	—	—	—	£1 0s.
United Electric Car Co.	£4 19s.	£8 18s.	£5 6s.	£5 5s.
Hurst, Nelson & Co.	£5 0s.	£8 2s.	£3 12s.	£4 5s.
Midland Railway Carriage Co.	£5 2s.	£10 16s.	£3 6s.	£8 0s.

Three tenders not to specification were submitted for one or more of the contracts for brake and sanding gear, &c. The Forced Lubrication Co. has secured, for £500, the contract for the supply of shafting, pulleys, &c., for the central car repair depôt in Woolwich Road, the Electrical Power Storage Co. is to repair the battery at the Victoria Embankment generating station, for £150, and Hadfield's Steel Foundry Co. is to supply, for £4,524 10s., special trackwork for the renewal of permanent way.

The following tenders have been considered by the Education Committee of the L.C.C. for the electric lighting and provision of fans for the undermentioned secondary schools:—

		Dawes Road, Fulham.	Hortensia Road, Chelsea.
G. N. Haden & Sons	(accepted)	£665	£685
Purcell & Nobbs		678	689
Pemberton, Arber & Co.		746	771
H. J. Galliers		764	770
Jenkins & Cawte		769	811
W. G. Cannon & Sons		870	867
G. Weston & Sons		890	931
Tilley Bros.		912	930
H. J. Cash & Co.		940	890
V. G. Middleton		951	933
A. Hawkins & Sons		997	884
Sweet Bros.		1,089	—
J. Bryden & Sons		1,182	1,142
G. Benkert		1,270	1,040
R. H. & J. Pearson		1,512	—
Efficient Electrical Engineering Co.		—	954

Malvern.—The U.D.C. has accepted the tender of the British Insulated & Helsby Cables, Ltd., for house service and fuse-boxes and compound, and that of Messrs. Siemens Bros. for meters.

Nelson.—The electrical fittings for the new Council schools, just erected in Bradshaw Street, were supplied by Messrs. Carter & Co., a local firm.

Plymouth.—Messrs. Bibby, Sons & Co. have received the contract to supply sheet copper, at £77 10s. per ton, to the electricity works department.

Portsmouth.—The T.C. has accepted the tender of Messrs. McMillan & Co. (representing the Electerisk Bureau, Ltd., of Christiania) for the supply of a 200-line telephone switchboard and 10 junction lines, at £104; and that of Messrs. Felten and Guilleaume, of Mulheim-on-Rhine, for telephone cables, at £313 12s. 11d. Motions to accept the tenders of the British Insulated & Helsby Cables, Ltd., at £118 10s. and £339 11s. respectively, were rejected. The T.C. has also accepted the tender of Messrs. Taylor & Co., of London, for the electric light installation at the new South Parade Pier, at £1,310. The highest tender was £3,480.

Richmond.—Messrs. Hemingway & Pritt, a local firm, have secured the annual contract for the maintenance of electric fittings at Mogden Isolation Hospital.

Whitehaven.—The following is a list of the tenders submitted for battery booster and switchboard for the electricity works:—

Switchboard (Delivery Only).

British Westinghouse Co.		£165
" "	(alternative)	144
Union Electric Co.		152
Siemens Bros. Dynamo Works		134
Ferranti, Ltd.		127
Crompton & Co.		127
Electric Construction Co.		123
Thos. Parker, Ltd.		122
India-Rubber, Gutta-Percha & Telegraph Works		117
A. Reyrolle & Co.		116
General Electric Co.		104
Bertram Thomas		101
Johnson & Phillips		100
Electric & Ordnance Accessories Co.		95
Cox-Walkers, Ltd.		94
Switchgear Co.		87
Whipp & Bourne	(accepted)	86

Battery Booster (Delivery Only).

Siemens Bros. Dynamo Works	£203
Electric Construction Co.	202
British Westinghouse Co.	185
C. Campars	177
Thos. Parker, Ltd.	177
India-Rubber, Gutta-Percha & Telegraph Works	159
Lancashire Dynamo Co.	159
Electric & Ordnance Accessories Co.	153
General Electric Co.	152
Crompton & Co.	142
Johnson & Phillips	140
Union Electric Co.	139
Phœnix Dynamo Co. (accepted)	124

Engineer's estimate for switchboard and booster, erected and connected complete, with battery meters (£30) £300.

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has accepted the tender of Messrs. Willans & Robinson for a turbine, and that of Messrs. Ferranti, Ltd., for a five-panel switchboard.

Yarmouth.—The Corporation on Tuesday accepted the tender of Messrs. R. Cory & Son, Ltd., for 500 tons of Pleasley hard coals, at 15s. 3d. per ton.

CONTRACTORS' COLUMN.

Openings for New Business.

ABERCARN (Mon.).—Twenty houses for the Rhysws Road Building Club, and 20 houses for the Gwyddon Road Building Club. J. W. Aldiss, architect, High Street, Newbridge, Mon.

ABERDARE.—Repairs to St. Fagan's Parish Church. G. E. Halliday, architect, 19, Castle Street, Cardiff.

Sunday School premises for the trustees of Siloa Independent Church.

Miners' rescue station at Aberaman for the Powell Duffryn Co., Aberaman.

ABERDEEN.—Premises at Provost Mearns' Quay for W. Lumsden, fish curer. G. Cowie, architect, Aberdeen.

Alterations and additions to fish-curing premises at North Esplanade West for G. Lees. W. F. McRobb, builder, Aberdeen.

ABERYSTWYTH.—Private residence for Councillor T. J. Samuel. J. Lewis Evans, architect.

Two houses in Prospect Street for Miss Evans, 15, Terrace. J. Lewis Evans, architect.

New bank for North and South Wales Bank Co. in Great Darkgate Street. Peter Edwards, builder, Chester.

Residence in North Road for Miss Ankers. J. Lewis Evans, architect, Aberystwyth.

Pavilion in Elysian Grove (seat 1,000), for R. C. Richades. J. Lewis Evans, architect, Aberystwyth.

Four houses in Portland Street for R. Owen, builder. G. T. Bassett, architect.

ACCRINGTON.—Houses, Pansy Street. J. Briggs, 4, Devonshire Street, Accrington.

ASTON.—Infirmary for the Aston Board of Guardians. C. Whitwell, architect.

ALCESTER (Warwickshire).—Proposed New Secondary School. Secondary and Technical Education Committee.

ANTRIM.—Alterations and additions to Crumlin Dispensary and medical officer's residence. J. Hunter, architect, Lisburn.

ARMAGH.—Town hall and municipal offices in contemplation.

BALLYMONEY.—Alterations to St. James's Church. W. J. Gillibrand, 9, Howard Street, Belfast.

BARNSLEY.—Eight houses at Darton. R. and W. Dixon, architects, 5, Eastgate, Barnsley.

Twelve houses and shop in Burton Lane, Monk Bretton. E. W. Dyson, architect, 10, Regent Street, Barnsley.

Houses, Harboro' Hill Road, for W. Robinson; Bond Road, for G. H. Gray; Oakwell Lane, for Geo. Haigh; St. John's Road, for S. Dryden; Langdale Road, for E. Staples; Langdale Road, for T. Wilkinson; shops, Eldon Street, for J. W. Rymer.

BAXENDEN (near Accrington).—Store room at Victoria Mill for Messrs. N. Worsley.

BECKENHAM.—E.L. installation in the Alexandra Schools for the Education Committee (£225).

BELFAST.—Re-building the Ulster Hospital for Women and Children.

Additions and improvements to licensed premises in Grosvenor Road and Abyssinia Street, for P. M. Namee. J. V. Brennan, architect, Belfast Bank Chambers, Belfast.

Extension of Sandy Row Orange Hall.

BEN RHYDDING (Yorks.)—Wesleyan Church (accom. 260).

BEXHILL.—Bungalow, Norman's Bay. H. Smith, owner. Fair & Myer, architects.

Dwelling-house, Sea Road, Cooden. Mrs. C. E. Smith, owner. A. S. Taylor, architect.

Detached residence, Sutherland Avenue. F. G. Miller, owner. A. A. Oakden, architect.

Additions to Birchington House, for ladies' school. Miss Ismay, owner. P. Morley Horder, architect, 148, New Bond Street, W.

BIRMINGHAM.—Council School at Little Green Lane, Small Heath. Architect, Education Department, Edmund Street, Birmingham.

BISHOPS STORTFORD.—Extension of Bishops Stortford College for the Governors (£5,000). F. S. Young, headmaster.

BOWCOMBE (Isle of Wight).—Bible Christian Methodist Church (£700).

BRANKSOME (Dorset).—Enlargement of the Church Army Hall.

BROMLEY (Kent).—Telephone Exchange. Bromley & Watkins.

BROADSTAIRS.—Dwelling house and two shops and houses in York Street, for T. J. Wardell; operating room at Signal Station, Northforeland Road, for the Committee of Lloyd's, London.

BROUGHTON (Manchester).—Extensions at Dye Works, for the Winterbottom Book Cloth Co., Ltd.

BUDBROOKE (Warwickshire).—School for the Warwickshire Education Committee (£2,226).

BURNHAM (Somerset).—Hotel (£20,000), for C. E. Pierson.

BURY (Lancs.).—Additions to the Grapes Inn, Bamford. Austin Porri architect, Victoria Buildings, Bury (Lancs.).

CAMBRIDGE.—Houses, Huntingdon Road, for the Vicar and Wardens of St. Giles' Church.

Six houses, Sturton Street, for W. Pate, James Street; tw Cherryhinton Road, for J. S. Conder, 146, Hills Road.

CANTERBURY.—Conversion of Guildhall Hotel, High and Guildhall Streets, into shop. G. Blakey, shop fitter, Market Street, Wakefield.

CARDIFF.—Y.M.C.A. premises in Edward Place (£4,200); chapel at Splott (£2,500); new fire station, with residences for 31 men, Cathay Park, for the T.C. (£24,597).

CARSHALTON (Surrey).—Houses, Gordon Road, for J. R. Barrage; Hill Road, for L. Alwyn; Carshalton Park Road, for R. G Medland.

CHELMSFORD.—Extensive additions to Skreens (Mansion), Roxwell, for Otho Shaw (£9,000 to £10,000). Jas. Strong, architect Liverpool T. J. Ward, builder, St. John's Street, Colcheste

CHESTERFIELD.—High School for Girls for Derbyshire C.C. G. H. Widdows, architect, St. Mary's Gate, Derby.

New Bank premises for William Deacon. W. C. Jackson, architect, Chesterfield.

Extensions to Chesterfield and District Co-operative Stores. Haslam & Sons, architects, Euclid House, Ilkestone, Derbyshire.

CHRISTCHURCH (Hants.).—House, Broadshard Lane, for H. Barrow; Lodge Entrance, for Colonel Peacock.

CIRENCESTER.—Restoration of the Town Hall. F. W. Waller, Diocesan architect.

COLNE (Lancs.).—Weaving shed at Barnoldswick for a new company.

Extension to United Methodist Schools in Exchange Street (£400).

CONWAY.—Proposed iron works (£10,000).

COTTINGHAM (Yorks.).—Houses, Finkle Street, for H. Whiting; and shops, Hallgate, for Miss Fincham.

DALMELLINGTON (N.B.).—Proposed Church Hall. A. C. Thomson, architect, Ayr.

DARLINGTON.—High School for Girls in Cleveland Avenue for the Durham County Council.

DARWEN.—Extensions at Cotton Hall Mill. Haworth & Smith, cotton waste dealers.

DERBY.—United Methodist Church in Corden Street and Pear Tree Road.

DONCASTER.—New Sunday Schools, Hyde Park (£1,450). H. Beck, architect, Dolphin Chambers, Doncaster; Mullins & Richardson, builders, Shotton Street, Doncaster.

DORCHESTER.—Proposed extension of the Missionary College (£2,000). E. Warren, architect.

DROYLSDEN (near Manchester).—Extension of Trinity Church (£1,500).

DUDLEY.—Training College. Crouch, Butler and Savage, architects, Birmingham.

DUNBLANE.—Queen Victoria Memorial Chapel. Governors of the Memorial School, Dunblane.

DUNSTABLE.—Houses, Cross Street, for Wood & Sons.

EASTBOURNE.—New Wesleyan church premises (£13,600). Rev. D. Heaton, minister.

EASTLEIGH (Hants.).—Twenty-two houses in Archer's Road. E. H. White, Newtown Road, Eastleigh.

Eighteen cottages in St. Mary's Road, Bishopstoke. S. Ryland.

EDINBURGH.—Rebuilding Rose Street Church (Rev. J. W. Kemp); residence for lady students in connection with the Missionary Training Institute.

EVESHAM.—Houses, Northwicke Road, for H. Bailey; warehouse, Vine Street, for White Bros., Ltd.

EXETER.—Detached residence at West Avenue. Ellis, Son and Bowden, architects, Bedford Chambers, Exeter.

Additions to the Devon and Exeter Boys' Reformatory, including gymnasium and workshop. E. H. Harbottle & Son, architects, County Chambers, Exeter.

FALMOUTH.—Fish curing stores for M. Dunn & Sons, Mevagissey and Newlyn. J. B. Hooper, architect, Looe.

Pair of semi-detached residences for Messrs. Eva & Bone. Miss Charles, architect, Falmouth.

FALSTONE (Northumberland).—New Colliery, electrically equipped, for the Falstone Coal Co., Ltd.

FARNBOROUGH (Hants.).—House, Osborne Road, for E. Brown; additions to "The Hermitage," for J. Sainsbury; school, North Farnborough, for Hants C.C.

FARNWORTH (near Bolton).—School room in connection with Market Street Church (£2,000).

FELIXSTOWE.—Private house in Orwell Road. F. C. Thurman, builder, Walton, Felixstowe.

Private houses in Tomline Road. T. Ward, builder, Felixstowe.

Private house in Fleetwood Road. Parker Bros., builders, Felixstowe.

FERRY HILL (Co. Durham).—Residence for Dr. Sheedy. C. Johnstone, architect, Victoria Street Chambers, Bishop Auckland.

FLEETWOOD.—Houses, Darbishire Road, for Lancaster & Atkinson.

GLAMORGANSHIRE.—Welsh Calvinistic Methodist Chapels at Peniel Green, Llansamlet and Cymmer.

GLASGOW.—School in Mollinsburn Street, for the Glasgow School Board. Dykes & Dale, architects, 65, West Regent Street, Glasgow.

GLENLIVET.—Buildings and alterations on Gordon-Richmond Estates. A. Thomson, architect, Fife-Keith.

GLOUCESTER.—Extension to Barnwood Asylum for the C.C. (£5,000).

GOSPORT.—Building in connection with Avenue Road Church.

GUISBOROUGH.—Houses, Allison Street, for J. G. Porteous.

GWAUN-CAE-GURWEN (Mon.).—50 houses for the Gwaun-cae-Gurwen Colliery Co. J. Cook Rees, architect, Neath.

HALIFAX.—House and shop at Bank Top, Southowram. G. C. Lloyd, architect, Imperial Chambers, Halifax.

HANLEY.—Offices in Cheapside. E. S. Challinor, Town Clerk.

Offices in Leek Road, for the Central Potters' Mill Co. Secretary.

HARDINGHAM. — Primitive Methodist Church. Rev. A. T. Wardle, Wymondham.

HARPENDEN. — Semi-detached houses, Tennyson Road, for the Misses Browne.

HASLINGDEN.—Warehouse, stables and house, Station Road, for Holden Bros.; houses, Bury Road, for Wm. Tattersall.

HELENSBURGH, N.B.—Villa in Upper Colquhoun Street, for Major J. F. Duncan, Millview. W. Leiper, architect, 121, West George Street, Glasgow.

HINCKLEY.—Infirmary for the Board of Guardians (40 beds).

Houses, Trinity Lane, for Mr. Hardy.

HITCHIN.—Houses, Baliol Road, for Mr. Knight, and London Road, for C. Ellcock.

HORDEN COLLIERY (Co. Durham).—Church (£2,000).

HUCKNALL TORKARD.—New baths, gift of J. E. Ellis, M.P. J. A. Munks & Son, builders, Hucknall Torkard.

HUDDERSFIELD.—Alterations and additions to the Slaithwaite Mechanics' Institute for the West Riding C.C. J. Vickers-Edwards, county architect, County Hall, Wakefield.

HULL.—Fish curing premises, stables, &c. Freeman, Son & Gaskell, architects, 11, Carr Lane, Hull.

ILFORD.—Schools for the U.D.C. Hammond & Sons, builders, Romford.

ILFRACOMBE.—Five pair semi-detached villas in Hele Road. H. W. Weir, 31, Greenclose Road, Ilfracombe.

Higher Elementary School in Marlborough Road, for the Devon County Council; rebuilding shop and dwelling house, 118a, High Street, for T. D. Harding, 118a, High Street.

IPSWICH.—E.L. installation at the Girls' Municipal School for the T.C.

KEARSLEY (near Bolton).—Conversion of Dolly Carter Inn, into cottages. Cornbrook Brewery Co., Manchester.

KING'S NORTON.—Secondary school in Northfield Road for the Education Committee.

KINGSTOWN (Co. Dublin).—Houses for the Urban Council (£15,000).

KIRKBY-IN-ASHFIELD (Notts).—Houses, Low Moor Road, for J. Blackburn Alfred Street, for Mr. Ladyman; Vernon Road, for Mr. Stubbins; Hodgkinson Road and Cobden Street, for Mr. Twelbridge; Nuncargate Road, for Mr. Bramley; Nuncargate Road, for Mr. Davies; Skegby Road and Main Street, for Mr. Colledge.

KIVETON PARK (near Sheffield).—Congregational Church at North Anston.

LAMPETER (Cardiganshire).—New premises for the London and Provincial Bank.

LEEDS.—New tannery at Churwell for W. L. Ingle, Ltd. T. A. Buttery, architect, 1, Basinghall Square, Leeds.

LEIGH (South Lancashire).—Housing scheme contemplated by the Corporation.

LICHFIELD.—School for the Staffs Education Committee (accommodate 360 scholars).

LINCOLN.—Houses, Pennell Street, for S. and R. Horton; Scorer Street West and Greetwell Gate, for the Lincoln Land and Building Society; Cecil Street, for C. Sands.

LINTON (Cambs.).—Sunday Schools (£1,200). Rev. S. J. Williamson, pastor.

LITTLE HULTON.—Proposed enlargement of St. Edmund's R.C. School. Rev. Father Ivory, Little Hulton, Bolton.

LIVERPOOL.—Proposed additions to the Adelphi Hotel, for the Midland Railway Co.

Imbecile wards at the Workhouse, Smithdown Road, for the Toxteth Park Board of Guardians. W. W. Thomas, architect, 15, Lord Street, Liverpool.

LLANDAFF.—Detached residence for F. T. Duncan. G. E. Halliday, architect, 19, Castle Street, Cardiff.

LLANELLY.—Thirty houses, in Temple Street and Temple Place, for J. B. Harris; six houses in Prendergast Street for D. Hopkins; seven houses in Prendergast Street for J. Charles.

LONDON (St. Pancras).—Enlargement of Mansfield Road (L.C.C.) School (400 places). T. J. Bailey, Education Architect, L.C.C., Spring Gardens, S.W.

(Wandsworth).—Elementary school, Hitherfield Road. T. J. Bailey, Education Architect, L.C.C., Spring Gardens, S.W.

(Hoxton).—Higher elementary school for L.C.C. (600 places). T. J. Bailey, Education Architect, L.C.C., Spring Gardens, S.W.

(Lee, S.E.).—Public school (800 places) in Manor Lane. T. J. Bailey, Education Architect, L.C.C., Spring Gardens, S.W.

(W.).—Block of flats and shops in North Audley Street. Harris and Gillow, 21, North Audley Street, agents.

(Paddington, W.).—School (850 places). T. J. Bailey, Education Architect, L.C.C., Spring Gardens, S.W.

(Stepney, E.).—Alterations, &c., at Trafalgar Square School. T. J. Bailey, Education Architect, L.C.C., Spring Gardens, S.W.

(White Hart Lane Estate).—Cottages for L.C.C. (£22,300). Rowley Bros., builders, Tottenham, N.

(Stepney, E.).—Public elementary school, Redman's Road, for L.C.C. (£14,414). T. D. Leng, builder, Evelyn Street, Deptford, S.E. T. J. Bailey, Education Architect, L.C.C.

(Rotherhithe).—Elementary school for L.C.C., Cow Lane (550 places). T. J. Bailey, Education Architect, L.C.C., Spring Gardens, S.W.

(Whitechapel).—School (600 places) in Buxton Street; and school (1,000 places) in Fairclough Street. T. J. Bailey, Education Architect, L.C.C., Spring Gardens, S.W.

(W.).—Alterations to 48, Wigmore Street for Allen & Hanbury, Ltd. (£2,050). P. K. Allen, Tunbridge Wells, architect; J. Greenwood, Ltd., builders, 10, Arthur Street, W.

(East Ham, E.).—Alterations to 145, High Street North. J. Stokes and Son, builders, High Street, East Ham.

(Catherine Street, W.C.).—Buildings. C. Crawley Cross & Co., surveyors, 76A, Chancery Lane, W.C.

(Kingsway, W.C.).—Buildings. Holland & Hannen, builders, Hyde Street, Bloomsbury, W.C.

(Hammersmith, W.).—Buildings with shops. C. J. C. Pawley, architect, 25, Victoria Street, S.W.

(Hammersmith Road, W.).—Laundry addition to St. Thomas's Seminary. Hubbard & Moore, architects, 112, Fenchurch Street, E.C.

(Barnes).—24 houses, Vicarage Road. E. & P. Hornsey, 8, Sheengate Terrace, Richmond.

(Muswell Hill).—14 houses. A. Deeks, Ilford.

(Croydon).—House in Lakehall Road. G. H. Bailey, contractor, 162, Sydenham Road.

(Barnes).—Boys' school, Lonsdale Road. Jarvis & Richards, 36, Victoria Street, S.W., architects.

(Hendon, N.W.).—Development of four roads and erection of four houses. Parker & Unwin, agents, Wildes Farm, North End, N.W.

(Hendon, N.W.).—Laundry, &c., Crewys Road. Turpie Bros., builders, The Ridge, Child's Hill, N.W.

(Mill Hill, N.W.).—Five houses, Marion Road. H. Champ, builder, 19, Victoria Parade, Muswell Hill, N.

(Hendon, N.W.).—101 houses in the Drive and Hamilton Road. Hamiltons, Ltd., agents, Child's Hill, N.W.

(Golder's Green, N.W.).—Eight shops, The Parade. Edmonsons, Ltd., builders and agents, Muswell Hill.

(N.W.).—Four houses, Audley Road. E. Evans, agent, 253, Lavender Hill, S.W.

(Hendon, N.W.).—Temporary estate office, corner of Woodstock Avenue and the Grove. Hamiltons, Ltd., agents, Child's Hill, N.W.

(Hendon, N.W.).—Drill Hall, Colin Deep Lane. Emden, Egan and Co., architects, 2, Lancaster Place, W.C.

(Hendon, N.W.).—Sixteen houses, The Drive, Woodstock Estate. Tucker & Huntley, architects, 22, Buckingham Street, W.C.

(Hampstead, N.W.).—Ten houses. Hampstead Garden Suburb Trust, Ltd., 32, Theobald's Road, W.C.

(N.W.).—Four houses, Rodborough and Hodford Roads. Barnet and Brotchie, builders, 68, Salusbury Road, Kilburn, N.W.

(Hendon, N.W.).—Extension to church, Colin Deep Lane. Vicar and Trustees.

(Mile End).—School (360 places), and adaptation of Essex Street Pupil Teachers' centre for public school (200 places). T. J. Bailey, Education Architect, L.C.C., Spring Gardens, S.W.

LONDONDERRY.—Rebuilding the Guildhall, recently destroyed by fire (£20,000).

LOWESTOFT.—Four houses, Royal Avenue, North Lowestoft.

Workshops, Belvedere Road. M. Bean, Belvedere Road.

LUTON.—Houses, Reginald Street, for Frederick Chandler, builder, 73, Cromwell Road, Luton; Hampton Road, for A. Mardle, builder, 18, Cowper Street, Luton; London Road, for Henry Impey; Kenilworth Road, for A. Cole, builder, 183, High Town Road, Luton.

New Baptist Sunday Schools (£5,100). T. and E. Neville, builders, 32, Castle Street, Luton.

MADELEY (Salop).—Secondary School at Coalbrookdale for the Madeley Union.

MANCHESTER.—Warehouse in York Street. Messrs. R. Neill & Sons, builders, Manchester.

MANSFIELD.—Boys' drill hall and club at Forest Town for the Bolsover Colliery Co. (£3,000).

MARGATE.—Shop and showrooms, Northdown Road, for M. Cobb.

Electric converting station. J. A. Forde, manager, Isle of Thanet Electric Tramway and Lighting Co., Ltd.

House and shop, Byron Road, for J. Rattray; additions to the Royal Sea-bathing Infirmary. W. Campbell Jones, architect, 7, Durham Place, Chelsea.

MITCHAM.—Buildings at Lower Mitcham Council schools (£1,246). A. W. Jarvis and F. A. Richards, architects, Surrey Education Committee.

MITCHELL (near Truro).—County Council School. B. C. Andrew, architect, St. Austell.

MOGERHANGER (Beds.)—County School for the Beds. Education Committee (£2,000).

MONMOUTHSHIRE.—Alterations and improvements at the Forest Council School for the Monmouthshire Education Committee. C. Dauncey, secretary, County Council Offices, Newport, Mon.

MORPETH.—Elementary schools for the C.C., near the Court House.

NEWCASTLE-ON-TYNE.—Schools at Seaton Terrace and Earsdon for the Northumberland Education Committee.

NEWPORT (Mon.)—Additions to Summerhill Baptist Church (£2,500). A. E. Sheppard, architect; E. F. King & Co., builders, Newport.

NOTTINGHAM.—Wesleyan place of worship and institute (£32,000). A. E. Lambert, architect, 22, Park Row, Nottingham.

OXFORD.—Important additions to Wesley Memorial Church.

PAISLEY.—Additions to works in M'Dowall Street, for A. F. Craig & Co.; alterations to public-house, for S. Young, 27, Lawn Street; additions to Nurses' Home, at the Alexandra Infirmary, for P. Coats, Garthland Place; engine shop, at works of T. White and Sons, engineers, Laigh Park; stable and store in Clark Street, for Jas. Picken, rope manufacturer.

PERTH.—Rebuilding of farm steading, at Jamesfield, Abernethy. G. Pearson, builder, Newburgh; MacLaren & McKay, architects, Perth.

PRESTON.—Houses at Penwortham, for Wm. Ward, John Marsden and J. Seddon.

POOLE.—Houses, Powell Road, for Baker & Pearcy; Pembroke Road, for Jas. Wellman; Bury Road, for T. F. Wiley (J. H. Brewerton, architect, Bournemouth); Penn Hill Avenue, for A. E. Hoare James & Son, architects); Kingston Crescent, for P. Coates; King's Avenue, for G. Watkins; Munster Road, for J. Wright; Banks Road, for E. Barrett; Woking Road, for W. G. Crane; Commercial Road, for Mr. Newton (James & Sons. architects); Rossmore Road, for E. Hunt; Canford Road, for W. Samways.

QUEENBOROUGH (Isle of Sheppey).—Three hundred houses on the Rushenden Estate. Mr. May, architect, London.

RAWMARSH.—Isolation Hospital for the Rawmarsh Isolation Hospital Committee (£4,000).

REDDITCH.—Extension of the Secondary School for the Higher Education Committee. B. Perrins, architect, Central Chambers, Redditch.

RHONDDA.—Extensions and alterations to Stanley School, Stanleytown, for the Rhondda U.D.C. W. P. Nicholas, clerk to the Council, Council Offices, Pentre, Rhondda.

ROCHESTER.—Extensive additions to Borstal Prison (£7,000 to £8,000).

ROTHERHAM.—Houses at Monksbridge Road, Dinnington, for Mr. Luctkar; Silverdale, Dinnington, for Mr. Hartley; Corden's Hill, Dinnington, for Whittaker & Barlow; residence at Tickhill for E. Clarkson.

ST. ALBANS.—Detached house, Lancaster Road, for A. C. McKenzie.

ST. ANNE'S-ON-SEA.—Primitive Methodist Church in connection with the St. Anne's-on-Sea Mission.

Houses, St. Annes Road East, for J. Prestwich; Headroomgate Road, for S. Wilson; Derbe Road, for J. Heap & Sons; Queen's Road, for Thos. Hedges and C. Bluhm; and St. Thomas's Road, for R. Crighton.

ST. AUSTELL.—Additions to County Secondary School for the Cornwall C.C. B. C. Andrew, architect, St. Austell.

ST. BLAZEY.—School for the Cornwall C.C. Bounsall & Oliver, builders, St. Blazey.

ST. GERMANS (Cornwall).—Wesleyan Chapel at Tideford. L. Scantlebury, architect, George Place, Callington, Cornwall.

SEDGEFIELD (Co. Durham).—Houses, Old Trimdon, for Mrs. H. Brown; Chilton Buildings, for Leonard & Atkinson; Chilton Buildings, for Dr. Shoedy.

SALE.—Cookery, laundry and housewifery centre for Cheshire C.C. E. J. Thompson & Son, architects, 19, Dickinson Street, Manchester.

SHREWSBURY.—Congregational Church in Queen Street.

SKEGNESS.—New school for Lindsey C.C. Scorer & Gamble, architects. Bank Street Chambers, Lincoln.

SKIPTON.—School at Salterforth for the West Riding of Yorks. C.C. J. Vickers-Edwards, county architect, County Hall, Wakefield.

SLOUGH.—New public house, The Swan, Salt Hill. Nevile, Reid & Co., brewers.

SOUTH SHIELDS.—New Infants' School, Mowbray Road, for South Shields Education Committee. H. Grieves, architect, Albany Chambers, King Street, South Shields.

SPALDING.—Christadelphian Hall in New Road. J. B. Corby & Son, architects, Spalding.

STAFFORD.—Motor accessories factory. Air Springs, Ltd., Craven House, Kingsway, London.

Church in Rowley Road (£2,000).

STAINLAND (Yorks.).—Re-erection of Bankhouse Mills for J. Maude & Son, blanket manufacturers. C. F. L. Horsfall & Son, architects, Lord Street Chambers, Halifax.

TAUNTON.—Villa at Mount Nebo for F. Buckland (electric main laid). M. Smith, architect.

Additions to residence of F. S. Arnold, Rowbarton (electric main laid). G. C. Strawbridge, architect.

Two houses in Cyril Street. Spranklin & Price, architects; Mr. Rabjohns, builder.

House at Staplegrove for Mr. Riddell. Messrs. Spranklin & Price, architects.

Slaughter-house for Wright & Co., pork merchants.

TARPORLEY.—County police station for Cheshire C.C. H. Beswick, county architect, Chester.

THORNHILL (Yorks.).—Houses, station road, for Wm. Graham; Hill Crest Road for L. Hinchcliffe.

THORNTON (Lancs.).—Bungalow residence, Beach Way, for John Jones; and house, Station Road, for John Hague.

THURLSTONE.—Shop premises. R. & W. Dixon, architects, 5, Eastgate, Barnsley.

TOLWORTH.—Parish Hall in Douglas Road, St. Matthew's parish.

TORPOINT.—County Council School (£4,500 estimated). B. C. Andrew, architect, St. Austell.

TORQUAY.—Extensive alterations to the Grand Hotel, for J. B. Giller.

TREDEGAR.—New Schools at Blackwood (£5,316). Mr. Bond, builder, Cardiff.

WADEBRIDGE.—Girls' County Council School (£470). B. C. Andrew, St. Austell, architect; T. Williams & Son, Wadebridge, builders.

WAKEFIELD.—Alterations, &c., to Outwood Provided School for the West Riding C.C. J. Vickers-Edwards, county architect, County Hall, Wakefield.

WALKDEN.—Model colony of dwellings contemplated. Walkden Co-operative Society.

Proposed laundry in Timmins Street. Miss Gill, Egerton Terrace, Walkden.

Extensions to motor houses at Lord Ellesmere's Bridgewater offices. Captain H. V. Hart-Davis.

Two houses in Walkden Road, Wallwork & Ireland; two houses in Moss Lane, G. Partington.

WARRINGTON.—Council School at Stockton Heath (£10,570). G. F. Ashton, clerk to the Stockton Heath Parochial Committee.

WARWICK BRIDGE (Cumberland).—School and master's house for the Cumberland Education Committee. J. Forster, architect, 13, Earle Street, Carlisle.

WATERLOO (near Liverpool).—Houses, Galloway Road, for Alfred Smith; Verdi Street, Seaforth, for the Great Central Railway Co.; additions to laundry, Brighton-le-Sands, for the Blundellsands Family Laundry Co.

WEST KILBRIDE (Ayrshire).—New Church (£2,500).

WEYBRIDGE.—Police Station (£3,700). County Surveyor.

WHITBY.—New institute at Sleights. E. H. Smales, architects, 5, Flowergate Whitby.

Houses, Stakesby Vale, for A. Palframan. G. S. French, architect.

Houses, Sleights Bank. D. Kitching, builder, Knaresborough.

WHITEFIELD (near Manchester).—Wesleyan Church. Mr. Brocklehurst, architect, Waterfoot, East Lancaster.

WIRKSWORTH.—House and farm building for G. J. Ogden.

WINCHESTER.—Soldiers' Home (£2,125). Wort & Way, builders, Castle Street, Salisbury.

WISHAW (N.B.).—Masonic Temple for Lodge St. Mary, Coltness, Wishaw, No. 81.

Twenty houses in John Street, Craigneuk. J. T. Bell, Paisley Road West, Glasgow.

Alterations to the Royal Hotel.

Extension of premises at Berry Hill for the Wishaw Co-operative Society.

WOLVERHAMPTON.—Additions to the works of the Chillington Tool Co., equipped for electrical power.

WOODHALL SPA.—Extensions to "Petwood" (residence) for the Baroness von Eckardstein.

WORCESTER.—Premises in Foregate for the T.C. (£2,085). Stokes Bros., builders, Worcester.

Secondary school for girls for the City Education Committee. City architect.

WORTHING.—Extensions to Swandean Isolation Hospital for the T.C. (£3,000).

YSTRAD RHONDDA.—Chapel in connection with the English Church (£1,300).

Business premises for the Ton Industrial Co-operative Society, Ltd. W. D. Morgan, architect, 194, Ystrad Road, Pentre.

FORTHCOMING EVENTS.

Tuesday, April 28th.—At 3 p.m. Royal Institution. Lecture I on "The Development of the Modern Turbine and its Applications," by Mr. G. Stoney.

At 8 p.m. Faraday Society. "The Planimetrical Analysis of Alloys," by Prof. A. K. Huntington and Dr. C. H. Desch. "The Interaction of Aluminium Powder and Carbon," by Messrs. F. E. Weston and H. Russell Ellis. "Technical Electrochemistry in Russia," by Prof. N. Piltschikoff.

Wednesday, April 29th.—At 7.30 p.m. At Finsbury Technical College. Institution of Electrical Engineers. Students' Meeting. Paper on "Radio-Telegraphy," by Messrs. Marvin and Smith.

Thursday, April 30th.—At 8 p.m. At the Institution of Civil Engineers. Institution of Electrical Engineers. The first Kelvin Lecture by Prof. S. P. Thompson, F.R.S.

Friday, May 1st.—At 9 p.m. Royal Institution. Discourse on "The Scientific Work of Lord Kelvin," by Prof. J. Larmor.

Friday, May 8th.—At 8 p.m. At the Royal College of Science, South Kensington. Physical Society. Paper on "An Examination of the Formulæ for the Grading of Cables," by Mr. C. S. Whitehead.

NOTES.

Helium not Solidified.—It was recently reported by Prof. Dewar that Prof. Onnes had succeeded in solidifying helium; he now writes to *The Times*, however, to say that he has received a telegram from Prof. Onnes, who finds that the momentary solidification observed was due to the unsuspected presence of hydrogen mixed with the helium, and that in fact helium has not yet been solidified. Prof. Onnes now considers that the critical temperature of helium cannot be higher than 5° absolute; and Prof. Dewar, who had hoped that it would not be lower than 8° absolute, regards the difficulties in the way so great that success cannot be attained without costly expenditure. It appears that in cases such as this, it is the last, rather than the first, step that costs. It is not long since it was considered impracticable to solidify or even to liquefy hydrogen; now we can approach within 10° or so of the absolute zero of temperature, which might be regarded as representing the physical death of matter.

Electrobus Run to Brighton.—On Sunday last an electrobus, similar to those which ply between Victoria and Liverpool Street, left London at 8 a.m. for a trip to Brighton, where it is to be put in service. The object of the trip was to demonstrate the ability of the vehicle to run the distance on one charge; unfortunately, it was marred by mechanical defects, which caused heating of the bearings on three occasions during the journey. An inaugural lunch followed at the Hotel Metropole, Brighton, when it was stated that the Electrobus Co. had run its vehicles in London at an inclusive operating cost of 9d. per car-mile, and had earned an average revenue during the past nine months of 13·1d. per car-mile.

Mine Telephones.—The desirability, say the *Financial News*, of having a telephone system for communication between the workings and the surface is recognised by every mine engineer, but the expense entailed by anything in the shape of a comprehensive equipment, as generally laid out, is prohibitive. However, Mr. J. J. Kinleyside, of the Lancaster Gold Mining Co., has just elaborated a scheme for reducing the cost to a very reasonable figure. All that is required, he says, is one good insulated wire, say a 7-18 strand, from the surface to the bottom of the mine, with tappings off at each level. This wire should be run through a bath of boiling tar before being erected, and fixed on porcelain bobbins attached to pieces of Oregon pine which have also been dipped in boiling tar and nailed to the timber work of the shaft. The line at the shaft head is attached to a two-way switch, one side of the switch being connected through an ordinary mine bell and 10-cell battery to earth, and the other side of the switch through a simple battery telephone set to earth. These telephones will cost from £1 to 30s. each, and are equal in efficiency to those costing £15, as far as practical work goes. At each level the branch wire tapping off the mains goes through one of these battery telephones to earth. The miner carries with him a key, in form like a half-inch brass plug. To call the banksman he presses a button; this puts the line to earth and rings the surface bell. Then he inserts his key; this connects his telephone on to the main wire and communication is made. These battery telephones can be placed in fairly watertight bell boxes and can be slung up anywhere. As no communition can be made without the key being inserted the system is absolutely fool proof. £100 would go a long way in equipping a mine with such a telephone system, and the future saving of time would be enormous. For surface communication a single wire exchange system is required. Again there is no need of expensive apparatus. Battery ringing telephones are quite good enough. A central telephone exchange would be placed in the general offices, with lines radiating to all the workshops, offices, stores, shaft head, and principal residences on the mine. The miner in a drive sends a message to the banksman, who, if required, communicates with the hospital, drill sharpener, or any department on the mine.

Institution and Lecture Notes.—American Society of Mechanical Engineers.—The semi-annual meeting will be held in Detroit, Michigan, June 23rd-26th. Among the papers to be presented at this session are "A Method of Cleaning Gas Conduits," by W. D. Mount; "A Method of Checking Conical Pistons for Stress," by Prof. George H. Shepard; "Clutches," with special reference to automobile clutches, by H. Souther; "Horse-Power, Friction Losses, and Efficiencies of Gas and Oil Engines," by Prof. L. S Marks; "Some Pitot Tube Studies," by Prof. W. D. Gregory; "The Thermal Properties of Superheated Steam," by Prof. R. C. H. Hock; "A Journal Friction Measuring Machine," by Henry Hess; "A By-Product Coke Oven," by W. H. Blauvelt; "Tests of Some High-Speed Steam Engines," by F. W. Dean. There will be a symposium upon machinery for conveying materials, with papers by several authorities. The Society for the Promotion of Engineering Education and the Society of Automobile Engineers will also hold their annual meetings in Detroit at this time, thus enabling members of each society to participate in the sessions of the other.

Northampton Institute.—Six lectures (advanced course) on "Wireless Telegraphy and Telephony" are to be delivered on Monday evenings, commencing on May 4th, at 7 o'clock, by Dr. J. Erskine Murray.

"Some Factors in High-Tension Power Transmission," was the subject of a paper read before the Toronto Section of the American Institute of Electrical Engineers, at a recent meeting, by Mr. David B. Rushmore. Among other things he drew attention to the gradual removal of the limitations in the matter of transmission voltage, in line insulators, and in lightning arresters. These improvements permitted the installation and operation of at least four lines in America at voltages higher than 60,000, one of them being designed for 100,000 to 120,000 volts. The improvement in the insulation of transformers, and the development of the multi-gap lightning arrester, have permitted the use of the new 60,000-volt lines. Damages sustained by electrical disturbances are, as recent studies show, unimportant when compared with those resulting from high-resistance earths on well-insulated lines, on either overhead or underground systems.

Institution of Electrical Engineers (Manchester Section).—The annual meeting of this Section took place on the 14th inst. Votes of thanks were awarded to the retiring chairman, Mr. M. B. Field; the hon. secretary, Mr. H. W. Wilson, who said the ordinary correspondence had trebled and the correspondence *re* papers had increased ten-fold; and to the Council of the University of Manchester and Prof. Rutherford for allowing the use of rooms for holding the meetings of the Section. The annual report was read, and stated that the membership of the Section was increasing; eight meetings had been held with an average attendance of 150. The following are the officers and committee elected for next session, viz.:—Chairman, Mr. Miles Walker; vice-chairman, Mr. S. J. Watson; hon. secretary, Mr. H. W. Wilson; committee, Messrs. W. Cramp, A. P. M. Fleming, J. Frith, G. Layton, V. A. H. M'Cowen, W. P. Maycock, J. S. Peck, P. A. Ramage, A. Schwartz, C. F. Smith, C. D. Taite, and A. P. Wood.

Institute of Marine Engineers.—The members of this Institute paid a visit on Saturday afternoon, April 11th, to the West Ham Corporation electricity works at Canning Town, by permission of the electrical engineer, Mr. A. Hugh Seabrook.

Junior Institution of Engineers.—Through the kindness of Mrs. Frank R. Durham, a bursary of the value of £25 per annum, to be called after the chairman of the Institution, the Durham Bursary, is about to be announced to the members and associates, of whom those between the ages of 20 and 22 will be eligible to compete by writing a thesis on some technical subject chosen by the candidate. Competing theses must be in the hands of the secretary not later than September 1st next.

At a recent meeting of this Institution, an interesting paper on "Automatic Fire Extinction as applied to Factories," was read by Mr. Geo. T. Bullock, chief surveyor to the Union Assurance Society.

Territorial Electrical Engineers.—In the Birmingham *Daily Post* of the 21st inst., a long account is given of the formation of the three companies of Electrical Engineers which are now being raised there, as part of the South Midland Division of the Territorial Army. These companies will form distinct units—wireless, air-line and cable—though for administrative purposes they will be jointly commanded by Lieut. J. F. Lister. The authorised establishment of the Telegraph Engineers is 498 men and 16 officers; up to the present about 100 men have been sworn in, and 120 are awaiting medical examination. The men are being recruited from the Postal Service, the National Telephone Co.'s staff, and students at the local technical colleges and the University, while the officers will be derived from the local section of the Institution of Electrical Engineers, which is playing a leading part in the work, at the invitation of the War Office.

The Cable Company is to consist of eight detachments, each having a wagon and material for laying and working a line ten miles long. While the Wireless Company is intended to establish communication between the base and any moving column, the cable telegraph will serve the communication from the base to the headquarters of the troops; and the continuance of the line of message to moving units, who will also have to keep in touch with the chief officer of the army in the field, will be the work of the Air-line Company. This unit also will consist of eight detachments, each having two wagons and material for erecting ten miles of air-line.

The Birmingham Engineers, before becoming Territorialists, belonged to the London Division, and had made a special study of searchlight signalling and submarine mining. Submarine mining work is now in the hands of the Navy, and the searchlight apparatus was recently recalled to London, the Birmingham men now having nothing to do with either of those branches. The London Division has recently had a balloon section attached to it, and there is a probability that the South Midland Division will also have a section attached to it, which will be controlled by the Birmingham Engineers.

All the big electrical firms in Birmingham have been asked to render the scheme whatever help they can, as well as the Birmingham Corporation Electrical Supply Department, Messrs. Bellis and Morcom, and the Wolseley Car Motor Co.

Gas on Electricity.—The gas producer has been abroad again, in the shape of an "eminent eye specialist," who expounded "facts" of the usual kind to the *Daily Mirror*. According to this credible authority, "In electric light the violet and ultra-violet rays of the spectrum prevail, while in the gas flame the red and yellow rays are most prevalent."

"The violet and ultra-violet rays are strongly chemical rays, and as in an electric battery we can get electricity from chemical action, so the chemical action of the violet rays on the eye sets up electric disturbances there, which lead in many cases to weakened eyesight. "Gas light," continued the doctor, "has, on account of its red and yellow rays, a stimulating effect upon the mind, which the electric light lacks, since in that the colder violet rays predominate."

These statements, and others, are reproduced under headlines about "Eyesight Dangers," "Electricity Condemned," &c., and will undoubtedly do much harm to the electrical industry, as they are obviously intended to do.

The truth, of course, is that the incandescent electric lamp gives out no more violet and ultra-violet rays than any other incandescent body, such as the incandescent gas-mantle, but apart from this, ultra-violet rays cannot penetrate glass, and as all electric lamps in practice are surrounded by glass, no ultra-violet rays are emitted at all, even from arc lamps; as for the violet rays, it is an ascertained fact that sunlight is richer in these than the electric light—hence, no doubt, the weak sight of many people who work in daylight.

"Inexactitude" is a feeble term for such libellous mud-slinging. Unfortunately, there is no means of punishing the authors.

Effect of Electricity on Plants.—The *Times* reports that the treasurer of University College, Bristol, has received a grant of £50 from the Board of Agriculture to enable the Department of Economic Biology to carry on its investigations on "the effect of electricity on plants."

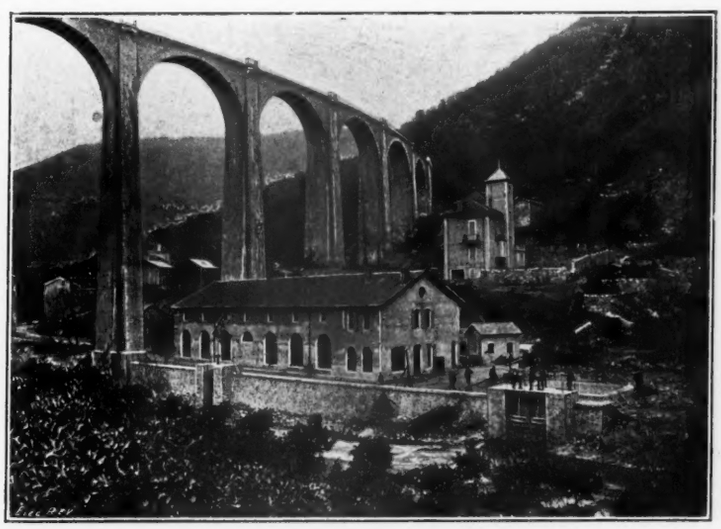
(*Continued on page* 708.)

THE ELECTRICAL INDUSTRY IN FRANCE.—III.

By GEORGES DARY (Paris).

The Distribution of Electrical Energy on the Mediterranean Coast.

In the interesting paper on the electrical power industry in England, recently presented to the Institution of Electrical Engineers in London by Mr. J. F. C. Snell, I note that he appears to recommend a method of co-operation between several generating stations and several distinct distributing systems under the direction of a controlling authority. This would be, according to Mr. Snell, the best remedy for the critical situation of certain distributing companies in England, and one of the only practicable methods of establishing a tariff acceptable to consumers, and, in fact, of establishing a paying and remunerative undertaking.

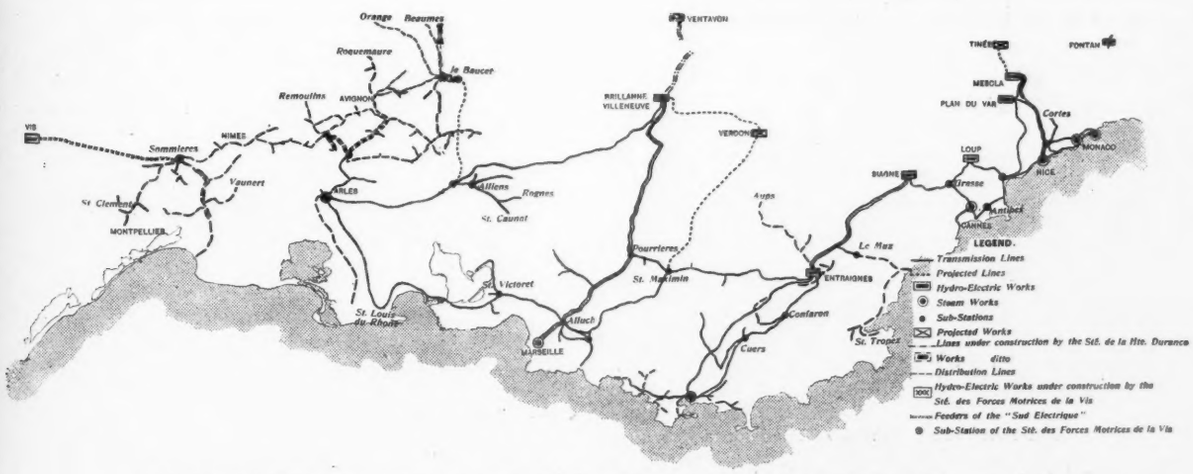


The Loup Hydro-Electric Station.

If, as I have already pointed out, we in France are in many cases scientifically the leaders, and though industrially behind some of our neighbours, we at least derive, from this commercial drowsiness, one great advantage—that of being able to profit by their examples, the errors they make and the experience they gain.

The huge organisation of the Société Energie Electrique du Littoral Mediterranéen would seem to fit in with the views of Mr. Snell; it is a modern example of the distribution of electricity over an extended area where the available supplies of water power, while numerous, are extremely irregular in their individual output, and can consequently only be arranged to give a regular supply by a system of general concentration.

Established in 1900 by the Compagnie Française Thomson-Houston and the La Société des Grands Travaux, of Marseilles, La Société Energie Electrique du Littoral Mediterranéen erected with its original capital the Pataras hydraulic station in the Gorges du Loup (Alpes Maritimes). It then acquired successively, the Mescla station on the Var, with the 10,000-volt line which connects it with the tramway station at Nice; and the Société des Forces Motrices des Alpes Maritimes, which enabled it to give greater homogeneity to its system. Finally,



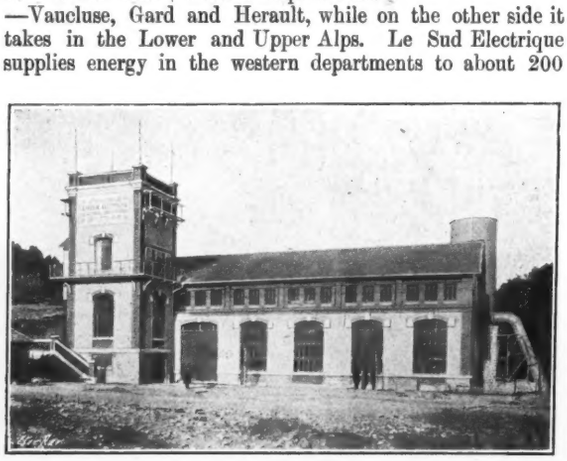
Map of the Transmission System of the Société Energie Electrique du Littoral Mediterranéen.

it established the Var system by the equipment of the Entraigues station, on the Argens, that of the Lower Alps, that of the Upper Alps, by purchasing the necessary rights for the construction of a fall on the Verdon, and negotiating with the Société des Forces Motrices de la Haute Durance for the supply of all the energy generated

by a station on the Durance, near Gap. In this way the company now actually controls a total of 56,000 H.P., of which 34,000 H.P. represents electrical energy generated by means of water power. Furthermore, the company has acquired powers to establish supplementary falls aggregating an almost equal capacity. The following table shows the different stations of the company, their capacity and location :—

Central station.	Water-power plant. H.P.	Steam plant. H.P.
Alpes Maritimes Department.		
La Mescla (on the Var) ...	2,000	—
Plan du Var	5,000	—
Pataras (on the Loup) ...	3,000	—
St. Cézaire (on the Siagne)	8,000	—
Cap Martin	—	300
Monte Carlo Superieur ...	—	900
Risso	—	4,000
St. Agathe...	—	2,000
Mougins	—	600
Var Department.		
Entraigues (on the Argens)	2,000	—
Brunet and La Loubière...	—	1,800
Bouches du Rhone Department.		
St. Giniez	—	8,000
Arles	—	4,000
Lower Alps Department.		
La Brillanne—Villeneuve (on the Durance) ...	14,000	—
Upper Alps Department.		
Société des Forces Motrices de la Haute Durance	30,000	—
Plant to be put down ...	—	6,000

An examination of the accompanying map of the feeder routes of the various generating plants of the Société du Littoral Mediterranéen, shows that the energy generated supplies three main systems — that of the Alpes Maritimes, that of the Var, and that of the Bouches du Rhone. Furthermore, by the intermediary of a branch concern "Le Sud Electrique" it extends over three other western departments —Vaucluse, Gard and Herault, while on the other side it takes in the Lower and Upper Alps. Le Sud Electrique supplies energy in the western departments to about 200

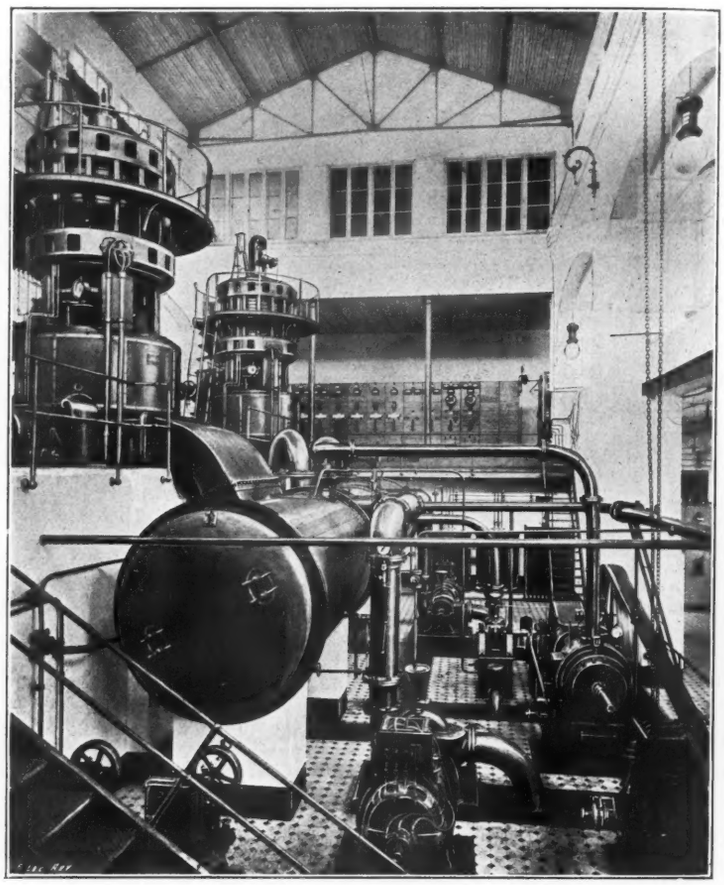


Hydro-Electric Station at Entraigues.

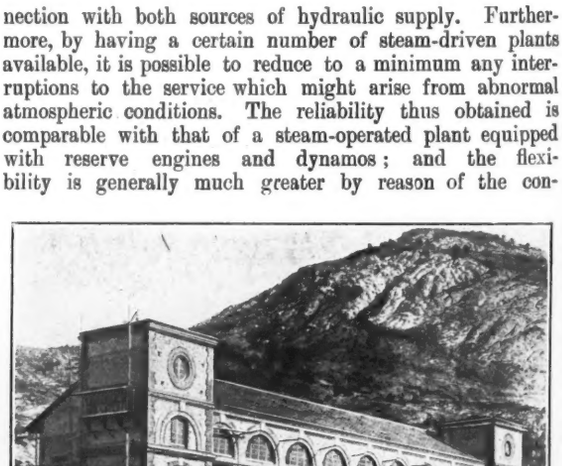
towns and villages, for the tramways in Avignon, and the requirements of the Compagnie d'Eclairage de Montpellier. While this electrical energy is partly furnished by the stations of the Energie Electrique concerns, Le Sud Electrique itself possesses several auxiliary steam-driven generating plants and a water-power station established by La Société des Forces Motrices de la Vis, which is at present in course of construction.

As we have already briefly indicated, the interest in this huge undertaking consists mainly in the reliability of operation resulting from the combination of different water-power generating stations. Some of them are established on streams of glacier origin, and others on rivers fed by the rain-fall. It is possible, therefore, by careful combinations of the different plants to eliminate the influence of periods of low water which arise at different seasons in connection with both sources of hydraulic supply. Furthermore, by having a certain number of steam-driven plants available, it is possible to reduce to a minimum any interruptions to the service which might arise from abnormal atmospheric conditions. The reliability thus obtained is comparable with that of a steam-operated plant equipped with reserve engines and dynamos; and the flexibility is generally much greater by reason of the considerable reserve power available. The company's scheme of operations is to :—

1. Transmit and distribute the electrical energy produced



View of the Risso Auxiliary Steam Plant, Nice.



Sub-station at Allauch.

by water-power plants, in the whole of the area comprised between the Rhone, the Durance, the Alps, the Roya and the Mediterranean.

2. Couple with one another the stations established on streams of different capacities, and so balance their output.

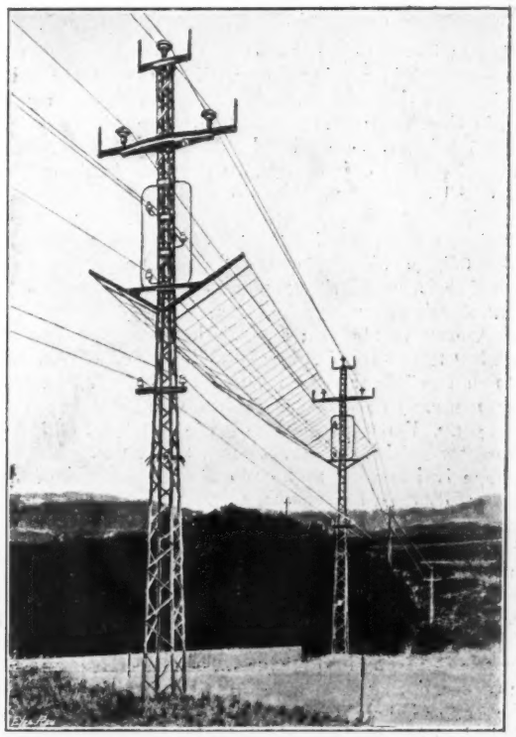
3. Arrange the systems in such a way as to divide the load, according to requirements, between the various generating stations without it being necessary to run plants widely separated in parallel—a plan which is not without great difficulties and serious inconveniences.

4. Control the largest possible number of steam-operated plants, intended as much to ensure the auxiliary service, in case of breakdown on the lines, as to permit of being ready to meet the requirements of consumers in the case of an extraordinary scarcity of water.

5. Control waterfalls of sufficient capacity to be able at any moment to supply the needs of the districts supplied.

6. To specialise in bulk supply, leaving as far as possible to clients or subsidiary companies the work of distribution to consumers.

50,000-volt Transmission Line.



Cradle Construction at Road Crossing.

The aggregate capital actually invested is £2,526,000, which will certainly suffice to carry through the whole of the scheme set out, which latter is, in fact, well advanced.

The following brief particulars of the stations, the systems and the organisation will give a fair idea of the undertaking.

Hydro-Electric Station at Brillanne.

The Alpes Maritimes System.—This system, which is maintained by 11,000-volt feeders, coupled up at the various points by means of secondary 2,200-volt circuits to distributing circuits at 115 and 230 volts, is supplied by three water-power operated central stations, viz., Mescla and Plan du Var, on the Var, and that of Pataras on the Loup.

The two first-named installations, operated by low falls without storage reservoirs, comprise three 800-H.P. sets at Mescla and three of 1,000-H.P. at Plan du Var for distribution purposes. Three other sets of equal power are employed to supply energy for the calcium carbide factory of La Société "La Lonza," which adjoins the station.

As regards the Pataras or Loup station, this utilises a waterfall of 820 ft. head, with a storage reservoir of about 230,000 cb. ft. capacity, and which is now being doubled in size. The plant comprises four 1,000-H.P. sets. The turbines are provided with governors and hydraulic servo-motors; the latter are extremely sensitive and enable a high degree of regularity in the running to be attained. The alternators furnish a three-phase 11,000-volt current. Of the auxiliary steam-operated generating stations, which are four in number, that located on the Boulevard Risso, Nice, may be mentioned. The plant comprises three turbo-alternator sets of 1,500 H.P. The turbines run at a speed of 1,500 R.P.M., and are of the Curtis vertical type, with four pressure stages; the 11,000-volt alternators are of the bi-polar pattern. Steam is furnished by seven multitubular boilers, fitted with superheaters and each capable of giving 8,800 lb. of steam per hour.

All these stations are equipped with Curtis turbines, and are connected with the first in such a way that the load can

be divided between them as desired. Large consumers are generally supplied from different generating stations.

In 1906 the various generating stations of the system supplied nearly 22,000,000 KW.-hours, divided as follows :—

The Var generating stations	(water-power)	10,730,000 KW.
The Loup "	"	9,430,000 KW.
The Risso "	(steam-power)	1,540,000 KW.

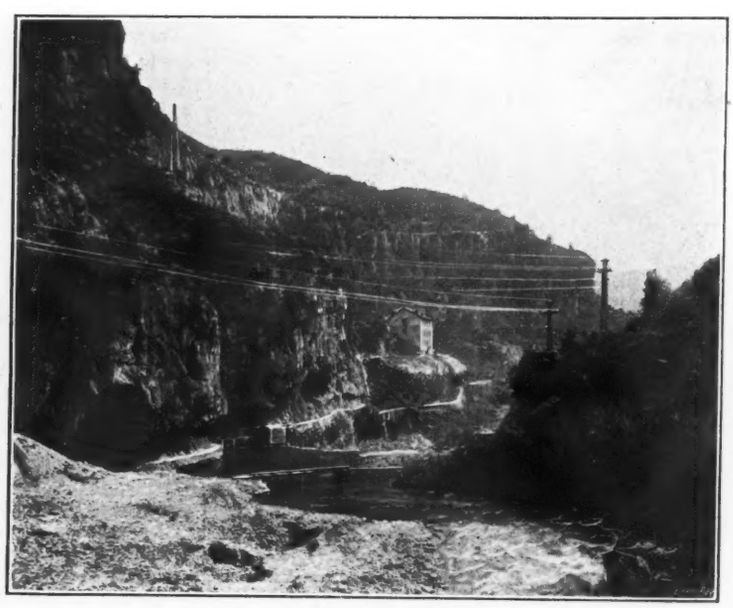
It may be mentioned that 11,000-volt underground cables are employed in passing through Nice, to connect the Loup station with that in Nice, for a distance of about 8 miles.

The Var System.—This system, which employs a pressure of 30,000 volts, was established after that of the Alpes Maritimes, its main object being to supply energy to Toulon. Two falls were utilised—one on the Argens, at Entraigues, and the other on the Siagne, at St. Cézaire ; the principal centres supplied being 38 and 62 miles away from these falls, a higher pressure than that employed in the case of the Alpes Maritimes plant was decided upon.

At the Entraigues station a natural fall of 59 ft. head on the Argens is utilised ; a regulating reservoir of approximately 2,120,000 cb. ft. capacity gives a supply of from 420 to 530 cb. ft. of water per second, representing from 2,000 to 2,500 H.P. The generating plant comprises three sets of 1,000-H.P. Francis turbines directly coupled to 3,500-volt alternators, which run at a speed of 300 R.P.M. The initial voltage is increased to 30,000 volts by the aid of transformers controlled at a distance by switches with electrical servo-motors. Transformer stations located at Toulon, Gonfaron, Cuers, &c., reduce the pressure again from 30,000 to 3,500 or 10,000 volts.

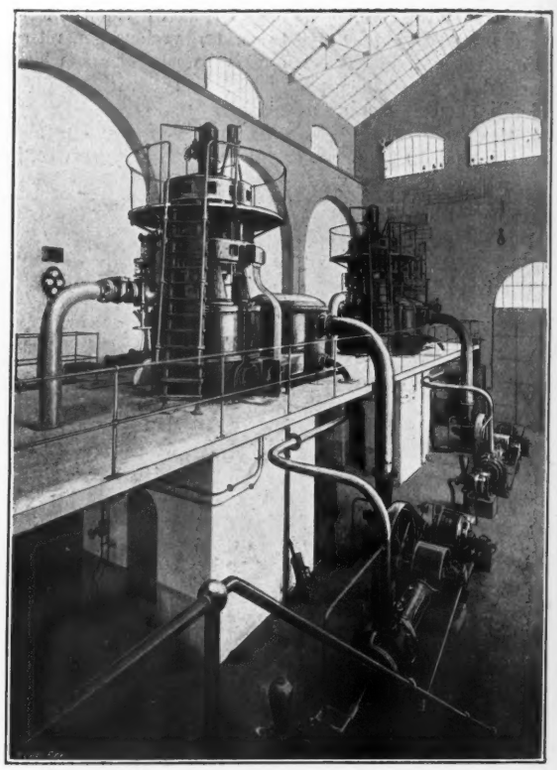
The Siagne station was established as an auxiliary to that at Entraigues, which quickly became unequal to the demands on the Var system. In fact, the latter was not long in extending into the St. Raphael and Frejus districts; moreover, during the summer season, the water supply of the Argens fell off considerably, consequently increasing the difficulty of maintaining the supply.

By a branch canal, $4\frac{2}{3}$ miles long, a fall of 1,148 ft. head was obtained, this giving a supply of 315 gallons per second ; the power available at the turbine shafts is about 10,000 H.P. The storage reservoir has a capacity of about 388,410 cb. ft. The generating plant consists of four sets of 2,500-H.P. turbines of the Pelton type, the horizontal shafts of which are coupled to alternators, which run at 375 R.P.M. Space is available for the installation of a fifth turbo-alternator set.



River Crossing, Marseilles Transmission.

To enable the neighbouring portion of the Alpes Maritimes to be directly supplied, a voltage of 11,000 has been adopted. As regards the Var system, these generating sets feed it through nine single-phase transformers of 750-KW. capacity, arranged triangularly, in groups of three, which raise the pressure to 30,000 volts. They are oil-insulated and air-cooled. A double line, between La Siagne and Entraigues, connects the Siagne station with the transformer station at St. Maximin, where connection is made by means of transformers with the Bouches du Rhone system.



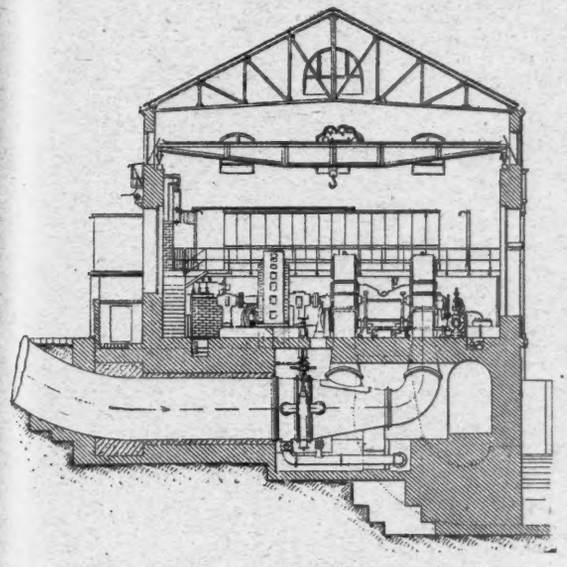
Auxiliary Steam Station at Arles.

A sectioning station at Entraigues enables the two Toulon lines to be fed by the Siagne station, concurrently with that at Entraigues.

The connection between the Var and the Alpes Maritimes systems is made at the Siagne station ; this, therefore, serves as a controlling point, for, as has been shown, it can supply current at either 30,000 or 11,000 volts. Secondary systems at 10,000 and 3,250 volts facilitate the feeding of the distributing circuits at 115 and 230 volts.

The Bouches du Rhone System.—In this case a pressure of 50,000 volts has been adopted. This system, which is fed on the one hand by the line from the Siagne station and on the other by the Durance and Verdun plants, forms the third section of the undertaking. The last-named water-power stations are three in number. The one on the Durance utilises a fall of 78 ft., and has a capacity of 14,000 H.P. ; it is located at La Brillanne-Villeneuve. The second, of from 18,000 to 20,000 H.P., is near Aiguines, on the Verdun, and the third, at present in course of construction, is at Ventadon, on the Upper Durance, and will, as soon as completed, supply 22,000 H.P. from a fall of 164 ft. Thus

there is altogether an average of 55,000 to 60,000 H.P. available to supply not only the Marseilles and Rhone districts, but also, through the Société du Sud Electrique, the Vaucluse, Gard and Herault departments, with the aid of the La Vis station now being constructed. It was on account of this that the high pressure of 50,000 volts was adopted. This pressure is confined to the main transmission lines, the



Sectional Elevation of the Brillanne Station.

principal distributing lines working at 13,500 volts, after the pressure has been reduced in suitably located sub-stations. Three of the latter are actually completed, viz. :—

1. The Allauch sub-station, in the Marseilles area, comprising 12 1,000-KW. single-phase transformers.

2. That at Arles, containing six 750-KW. transformers.

3. That at St. Maximin, with three 750-KW. transformers.

Of the three water-power generating stations, only one, and that the least important, is actually at work—that at La Brillanne ; the others are, however, almost completed, and will be set to work at an early date.

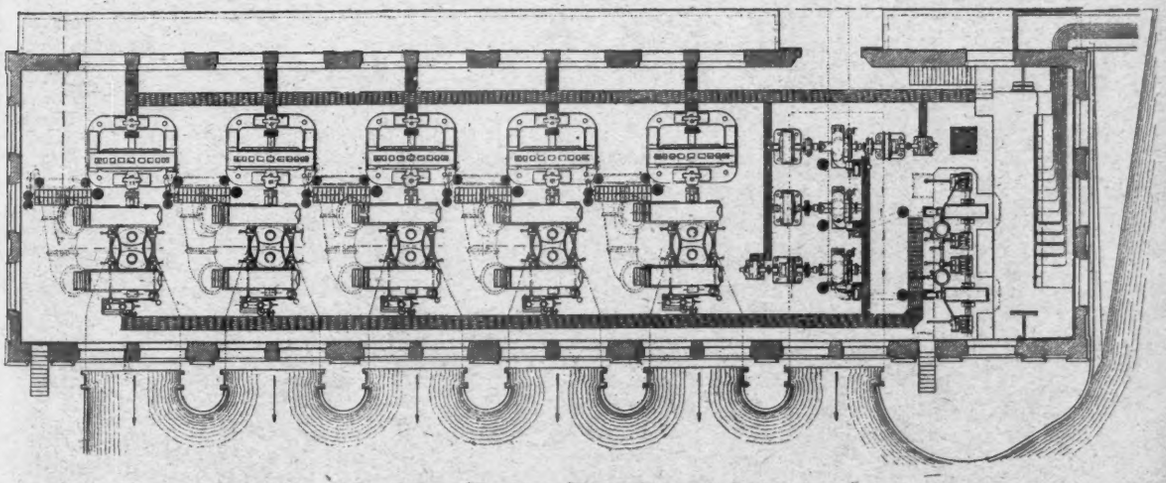
Located on the Durance, the water to this station is supplied by a branch canal 5⅝ miles long, at the rate of 2,118 cb. ft. per second. The actual conducting canal is 4⅓ miles long, and 32·8 ft. wide, with a water-chamber area of 9,570 sq. yards. From the latter, five pressure supply pipes of sheet-steel covered with cement, 8 ft. 10 in. diameter, lead to the five main turbines. A sixth pipe, 3 ft. 11 in. diameter, feeds three units for the auxiliary services, which absorb 1,050 H.P.

The generating plant consists of horizontal-shaft turbines of the Francis type, taking from 530 to 565 cb. ft. of water per second, and developing 3,500 H.P. at 250 R.P.M. The controllers are provided with oil-pressure servo-motors, the pressure of, roughly, 360 lb. per sq. in. being obtained by four pumps driven by a couple of 25-H.P. Pelton turbines. The alternators, which have fixed armatures, are direct coupled to the turbines, and are adapted for a pressure of 7,500 volts at a frequency of 25.

The auxiliary groups comprised (1) a 200-KW. exciting dynamo and one of 50 KW. for the internal service of the central station, both being driven off one 350-H.P. turbine ; (2) a 250-KW. 13,500-volt alternator ; (3) a spare machine of the same power for use in case of breakdown of the previously mentioned sets. These two units are employed for lighting the villages in the neighbourhood of the station. The initial pressure of 7,500 volts is raised to 50,000 volts by 15 water-cooled oil transformers of 900-KW. capacity each, which are arranged in groups of three to each alternator, and located, together with all the necessary apparatus and the leads to the transmission lines, in a separate building.

Each of the units can be connected to one or other of the two series of 50,000-volt bus-bars, to which may be coupled the transmission lines from Ventavon, or those leading to Marseilles or Arles, in such a way that from this point the whole power of the system can be controlled and distributed.

The transformers are located on the ground floor, while all the control gear is on the floor above. The oil switches are controlled by electric motors ; all the connections and



Plan of the Brillanne Hydro-Electric Station.

The auxiliary supply is assured by three supplementary steam-driven plants :—

One at Arles, comprising three 1,500-H.P. Curtis turbines and alternators.

One at Marseilles with five similar sets each of 1,500 H.P. ; a sixth set is shortly to be installed.

The third station is also in Marseilles ; it contains three 1,500-H.P. sets, and will shortly be increased by a fourth 1,500-H.P. unit, and a fifth of 5,000 H.P.

operations of the switches are indicated by lights on the station switchboard, lamps of different colours being employed to show the opening and closing of the circuits.

For the 50,000-volt transmission lines, the iron masts are 40 ft. high and set every 76½ yd. ; they carry six conductors, of which three, arranged in the form of an equilateral triangle having 5¾ ft. sides, are at the top of the masts ; the other three are carried below. The three upper conductors, which are of copper with a jute core, have a useful section of ·1 sq. in. ;

they transmit the current at 50,000 volts; the lower three, of copper wire of from 6 to 9 mm. diameter are used for the transmission of the distribution current at 10,500 volts. The separate triple-shed insulators have been tested to 70,000 volts; the breakdown test of the insulating material was carried out at 120,000 volts.

When completed, the high-tension lines will have a total length of about 375 miles. The protection of the lines is effected by Wirt lightning arresters, pointed arresters with liquid resistances, water discharges and lightning conductors. The underground cables are protected by choking coils and pressure limiting devices.

La Société du Littoral Mediterranéen has entrusted the hydraulic portion of the work to La Société des Grands Travaux, of Marseilles, and to Messrs. Giros & Loucheur; while La Compagnie Française Thomson-Houston has the contract for the equipment of the stations and sub-stations, as well as all the high-tension apparatus. As regards the class of clients the company desires and for which it caters, we have already mentioned that it consists of large consumers and concessionaries of public services (transmission and distribution of electrical energy) in the district covered. It is in this connection that the company assisted in the formation of La Société du Sud Electrique.

To mention several of the more important undertakings it can now supply:—

The tramway companies of Nice and the Littoral; the tramway companies of Cannes; the tramway companies of Marseilles; the Turbie Railway; La Compagnie de Gaz et de l'Electricité, of Nice; La Société de Distribution, of Monte Carlo; La Compagnie d'Electricité du Sud Est; La Société Aixoise d'Electricité; La Compagnie des Chemins de Fer de la Camargue, &c. At the same time the company has had to undertake the direct supply to certain isolated consumers on the route of the distributing mains.

Altogether La Société du Littoral Mediterranéen is supplying electrical energy to 10 tramway and railway companies, to 16 electricity distributing concessionaries, one of which—Le Sud Electrique—is supplying an area having more than 400,000 inhabitants. Furthermore, 83 municipalities are directly supplied, in addition to 256 whose requirements are met indirectly, representing a total of 1,600,000 inhabitants.

This brief outline of the undertaking will give some idea of the colossal efforts which La Société du Littoral Mediterranéen is making to distribute electrical energy throughout the whole of South-Eastern France, and it may be said that, thanks to the endeavours of this huge undertaking and to the well-conceived plans for utilising the hydraulic resources of the district, France is again taking a prominent place in the electrical world—a position to which it is entitled by reason of its scientific record, to some extent representing, as it does, the history of electrical progress. [We are indebted to *Le Génie Civil* for the sectional drawings of the hydro-electric plant at Brillanne.—Eds. E.R.]

NOTES.

(Continued from page 702.)

The Utility of the Municipal Electrical Association.—At the meeting of the Londonderry Corporation on 16th inst. the question of sending a delegate to the annual conference of the Municipal Electrical Association at Nottingham in June next was discussed. A councillor strongly objected to the sending of two delegates on the score of expense, adding that he had never met a member of a deputation who was able to point to one particle of good resulting. Mr. R. V. Macrory, the electrical engineer, was called in and questioned on the utility of deputations. He said that as the result of a conversation at the last conference he was enabled to save £37 per annum on one boiler. Some 200 municipalities were represented at the conference. It was finally decided to send the engineer.

The Beckenham U.D.C. has also had a long discussion upon a recommendation that the resident engineer be authorised to attend the convention, and that the delegate's fee of 10s. 6d. be paid. The arrangement suggested as to the resident engineer's expenses was that they be allowed up to £10, and be added to his salary for the current year. Several councillors objected to the proposal on the ground that it would be a waste of money, and doubt was expressed whether the auditor would pass the amount when it came before him. Mr. Dykes, in supporting the recommendation, said that the papers read at the convention of the Incorporated Municipal Electrical Association were thoroughly practical and, perhaps, still more useful were the informal discussions that the members had amongst themselves. In the result the Committee's recommendation was adopted by eight votes to four.

Imprisoned Electricians.—The four English electricians, whose names are Hogarth, Robinson, Cowan and Burton, are still detained in prison at Antwerp, the sum of £800 demanded as bail not having been forthcoming. Much indignation is expressed by the English residents at the four weeks' delay in bringing them to trial. The accused persons were in the employ of the Bell Telephone Co. at Antwerp, and had accepted engagements with the General Electric Co., Ltd., of London; they were arrested on the point of departure from Antwerp, on the charge of stealing documents.

As we go to press we learn from the daily papers that on Wednesday the prisoners were released unconditionally, by order of the Court of Appeal at Brussels, and the £800 bail, provided by the British Consul on their behalf, was repaid.

Smoking Concert.—At Chelmsford on Wednesday, 15th inst., the staff of the Electric Supply Corporation, Ltd., held a smoking concert, Mr. J. Eustace, the manager, presided, with Mr. W. Pleasance in the vice-chair.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review posted as to their movements.

Central Station Officials.—The staff and employés and friends of the Bolton Electricity Department, to the number of 60, dined together on Wednesday evening last week at the Halliwell Lodge Hotel. Earlier in the day a football match was played between the works team and a team got together by Mr. S. C. Manchester (engineer), the latter winning by 1—0. Among those present were the chairman of the Electricity Committee (Alderman J. Berry, J.P.), the vice-chairman (Councillor J. W. Marshall), the borough electrical engineer (Mr. A. A. Day, M.I.E.E.), and Mr. W. J. Wood (station superintendent). Alderman Berry submitted "The Bolton Corporation Electricity Works," and in doing so rejoiced that the department had such a grand set of men; he was also glad to think that they were happy at their work under Mr. Day and Mr. Wood, and referred to the development of the department. Mr. Day, in responding, said it was something to be proud of that, although they had not the largest station in the country, they had held the cost record two or three times during the last few years. They had what was a vital matter in connection with all municipal undertakings, *i.e.*, a good depreciation fund. It was larger than some authorities had, but he was convinced that they had not overdone it. They had paid £100,000 off capital account in 13 years, and mainly during recent years, and had also paid over for the benefit of the ratepayers £40,000. This was not a bad record, and the credit was due not to any individual, but to all.

We learn that Mr. R. B. Leach, electrical engineer and general manager to the Farnworth U.D.C. electricity department, has been the recipient of thanks by his Council, through a special resolution, for engineering services rendered in connection with his now accepted partial bulk supply scheme from the Lancashire Electric Power Co. Mr. Leach has been responsible for the progress of the Farnworth undertaking for over three years.

The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has increased the salary of Mr. Ambler from £180 to £200 per annum.

The Swindon T.C. has increased the salary of the borough electrical engineer from £200 to £250.

The Northampton Tramways Committee has appointed Mr. Cameron, the present assistant electrical engineer, to succeed Mr. J. McMahon as electrical engineer.

Mr. R. H. S. Button has been promoted to charge engineer in the Plymouth central station in the place of Mr. F. Hayes, who has been promoted to assistant electrical engineer.

Tramway Officials.—Mr. J. McMahon, the chief engineer and deputy general manager of the Northampton Corporation electric tramways, was on Saturday, the recipient of two presentations on severing his connection with the undertaking, in order to become the manager of the Dumbarton electric tramways. The borough officials presented Mr. McMahon with several pieces of plate, and Mr. J. Gottschalk (tramways manager), handed to Mr. McMahon a gold albert and medal, gift of the tramways staff. Mr. McMahon was appointed chief electrical engineer for the construction of the Northampton tramways in January, 1903, having prepared plans and specifications for the scheme, and when the work was completed he was retained as chief engineer and deputy general manager.

General.—At a meeting of the American Academy of Arts and Sciences in Boston, Mass., on the evening of Wednesday, April 8th, Mr. Edward Goodrich Acheson, of Niagara Falls, was

presented with the Rumford Medals. In his address, Prof. Charles R. Cross, chairman of the Rumford Committee, said: "Interesting as was the work of Moissan in the fabrication of artificial diamonds, the work of Acheson far transcends it, for it is a contribution to the direct progress of man." Prof. John Trowbridge made the presentation of the medals, one of gold, the other of silver. One side of the medals bore the inscription, "Rumford Medal for Discoveries in Light and Heat. Awarded by the American Academy of Arts and Sciences to Edward Goodrich Acheson for New Industrial Products of the Electric Furnace."

Alderman Beale has resigned the chairmanship of the Birmingham Corporation Tramways Committee, as he is unable to hold office as chairman of both that and the Water Committee. Councillor Barrow has been appointed in his place.

Mr. R. Ley Alkin, A.M.I.E.E., of the well-known electrical engineering and contracting firm of L. J. Healing & Co., of Yokohama, Kobe and Tokio, will shortly arrive in England on a business and pleasure trip. His address will be c/o Tozer, Kemsley and Fisher, Ltd., 84, Fenchurch Street, E.C.

We are informed that the following have been appointed to the vacant junior assistantships in the National Physical Laboratory:—Mr. J. R. Pennell, who holds the diploma in Engineering of the Northampton Polytechnic Institution, and the diploma in Electrical Engineering of the City and Guilds Institute; Mr. A. Kinnes, B.Sc., a graduate in Engineering, St. Andrews, who holds the diploma in Electrical Engineering of the City and Guilds Institute; and Mr. H. C. Booth, A.R.C.Sc., an Assistant Demonstrator in Physics at the Royal College of Science, who was previously Assistant Demonstrator in Engineering.

Mr. John J. Inniss, M.I Mech.E. (who, by the way, was the first President of the Birmingham and District Electric Club), has been on a business tour through China since last November. We understand that Mr. Inniss has opened out a branch office in connection with his firm, Messrs. Inniss & Riddle, of Birmingham, at 40, Szechuen Road, Shanghai, where the firm will conduct their Chinese business as consulting, electrical and mechanical engineers, machinery and general import merchants.

Obituary.—John Albert Brill.—Mr. J. A. Brill, a vice-president, director and one of the founders of the J. G. Brill Co., of Philadelphia, U.S.A., passed away on March 25th, at the age of 56.

William Ainsley Kreidler.—Mr. W. A. Kreidler, who founded the *Western Electrician* of Chicago, in 1887, and conducted it until March 25th this year, when he became ill, died on March 26th, in his 50th year, from an attack of apoplexy.

George Rathbone.—The *Times* reports that an electrical engineer named George Rathbone was killed in a motor accident last Saturday week at Lubenham, Market Harborough. The car came into collision with a trap.

NEW COMPANIES REGISTERED.

Calmont King & Co., Ltd. (97,616).—This company was registered on April 15th, with a capital of £3,000 in £1 shares, to carry on the business of electrical engineers, commission agents, factors, warehousemen, carriers, importers, exporters, &c. The subscribers (with one share each) are:—M. Wolff, 172, Lordship Road, N., merchant; E. Browne, 105, High Street, Eton, electrical engineer; A. J. Mardlin, 202, Amhurst Road, N.E., electrical engineer; R. E. Jones, 260, Dalston Lane, N.E., cycle factor; A. J. Winser, 14, St. James' Avenue, Cricklewood. N.W., manufacturer's agent; H. E. Patterson, 62, Upper Richmond Road, East Sheen, traveller; R. Dickens, 33, Chelverton Road, Putney, S.W., clerk. No initial public issue. The first directors are A. J. Mardlin, E. Browne and M. Wolff (all permanent; special qualification, 300 shares).

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Westinghouse Electric and Manufacturing Co., Ltd. (62,919).—A trust deed dated March 27th, 1908, to secure £300,000 6 per cent. prior lien debentures, has been registered. Property charged (specifically): The company's lands and works at Trafford Park, Manchester, with fixtures, fixed plant and machinery thereon (subject to certain rent-charges, rights and obligations), ranking in priority to trust deeds dated February 18th, 1902, August 31st, 1903, and August 2nd, 1904, securing £1,462,500 debenture stock. (As a floating security): The company's general assets, present and future, including uncalled capital, ranking in priority to the said trust deeds. The company may not create any mortgage or charge, ranking in priority to or *pari passu* with the present debentures, upon its materials, supplies, apparatus in course of manufacture, or on consignment, finished products, loose machinery, plant, tools, dies, equipment, patents or goodwill. Trustees: Merchants' Trust, Ltd., 53, Cornhill, E.C.

Copingers, Ltd. (90,438).—This company's annual return was filed on February 7th, when 787 shares had been taken up out of a nominal capital of £2,000 in £1 shares. £37 has been received and £760 is considered as paid. Mortgages and charges: Nil.

Marten & Jellicoe, Ltd. (mechanical and electrical engineers, London) (94,313).—Issue on April 2nd of £200 5 per cent. debentures, part of series created September 13th, 1907, to secure £10,000, charged on the company's property, present and future, including uncalled capital. No trustees. Previously issued of same series: £3,700.

Associated Battery Co., Ltd. (94,173).—Issue on April 6th of £100 5 per cent. debentures, part of series created February 20th, 1908, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £1,075.

Warriner, Ltd. (91,298).—This company's annual return was filed on March 18th, when 607 shares had been taken up out of a nominal capital of £1,000 in £1 shares, £1 per share has been called up on 157, 10s. per share on 300, and 6s. 8d. per share on 150, and £357 has been received. Mortgages and charges: Nil.

Electromobile Co., Ltd. (London) (75,139).—A memorandum of satisfaction in full of a mortgage dated July 19th, 1906, securing an indefinite amount, but stamped to cover £20,000, has been filed. A mortgage dated March 25th, 1908, to secure £12,000, has also been registered. Property charged: Interest under an agreement for lease of certain freehold hereditaments, and assignment of certain leasehold hereditaments in St. George's, Hanover Square, W., and the company's undertaking and property, present and future, including uncalled capital. Holders: North of England Trustee, Debenture and Assets Corporation, Ltd., 104, King Street, Manchester.

Oldbury Steel Conduits, Ltd. (84,113).—A debenture dated April 2nd, 1908, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: T. Pollock, Churchbridge, Oldbury.

Electric Canal Haulage Co., Ltd. (60,462).—This company's annual return was filed on February 22nd, when seven shares had been taken up out of a nominal capital of £3,000 in £1 shares. £7 has been received. Mortgage and charges: Nil.

Egerton & Co., Ltd. (66,172).—This company's annual return was filed on February 24th, when 1,511 shares had been taken up and paid for in full, out of a nominal capital of £2,000 in £1 shares. Mortgages and charges: Nil.

Keighley Electrical Engineering Co., Ltd. (44,893).—This company's annual return, made up to September 27th, 1907, was filed on January 29th, 1908. 4,100 ordinary and 1,600 preference shares have been taken up out of a nominal capital of £10,000 in 7,000 ordinary, and 3,000 preference shares of £1 each. £1 per share has been called up on 2,488 ordinary and 1,200 preference shares, resulting in the receipt of £3,688. £2 012 is considered as paid on 1,612 ordinary and 400 preference. Mortgages and charges: £3,000.

Reliance Works Co., Ltd. (electrical engineers, Southampton) (81,358).—Issue on March 31st, of £200 5 per cent. debentures, part of series created June 25th, 1907, to secure £2,000, charged on the company's property, present and future, including uncalled capital. No trustees. Previously issued of same series: £1,200.

United Electric Car Co., Ltd. (57,082).—This company's annual return, made up to October 3rd, 1907, was filed on February 5th, 1908. 150,000 ordinary and 100,000 preference shares have been taken up out of a nominal capital of £300,000 in 150,000 ordinary and 150,000 preference shares of £1 each. £250,000 has been received. Mortgages and charges: £50,000.

CITY NOTES.

Dudley, Stourbridge and District Electric Traction Co., Ltd.

The report for 1907 states that the gross receipts for the year amounted to £46,254. After deducting all expenses chargeable to revenue, including repairs and maintenance, and placing £2,000 to renewals account, there remains £11,898. After paying preference dividend, the directors are placing to the sinking fund £1,000, to depreciation and reserve fund £1,000, and they recommend a dividend at the rate of 5 per cent. per annum on the ordinary shares £5,000, leaving to be carried forward £948. The amount available for distribution is apparently less than in 1906, owing to the directors having decided to charge a larger amount to renewals account before arriving at the balance, rather than appropriating it after ascertaining the balance. The expenditure on capital account has been £532. The appeal to the House of Lords by the Corporation of Dudley was decided against the company. The effect of the decision is that the company will receive £16,028 less than had the railway been purchased under the Light Railways Act, but the rent to be paid under the lease will be correspondingly reduced. Efforts are now being made to complete the sale, and to settle the terms of the lease. It is proposed to enter into an agreement with the Birmingham and Midland Co. and the Shropshire, Worcestershire, and Staffordshire Electric Power Co. to sell to the Power Co. the generating stations at Hart's Hill, Amblecote, and Lye. As a condition of the sale of the generating stations, arrangements will be made for obtaining a supply of power from the Shropshire Co. at favourable prices. The arrangement for the management of all the tramways in the Black Country by the Joint Committee has continued to work satisfactorily, and the agreement with the other companies operating in the district has been continued for a further period. There were 8,303,032 passengers carried against 8,432,344; the average receipts per passenger were 1·32d., against 1·18d.; the average working expenditure per passenger was 0·80d., against 0·78d., and the proportion of expenses to receipts 61 per cent. against 60 per cent.

Harrow Electric Light and Power Co., Ltd.

The directors report satisfactory progress made during 1907. Although the new lamp connections do not reach the total obtained in 1906, the sale of electrical energy has increased by 53,000 units, which is the largest increase recorded since the starting of the supply. In view of the continued growth of the demand the directors have a scheme under consideration for the provision of additional generating plant. In the North Metropolitan Electric Power Co.'s Bill of last session, a clause for the protection of the Harrow Co. was inserted, stipulating that the Power Co. shall not

supply energy within the urban district of Harrow without the consent in writing of the Harrow Co. During the year the directors have written off a number of old accounts in the wiring department, which were found to be uncollectable. The total of these accounts was £76 in excess of the sum standing to the credit of the bad debt reserve fund, and that amount has accordingly been charged against the wiring department for the year. As a consequence the wiring account shows an apparent loss of £17 11s., whereas the actual result was a profit of £58. The total receipts for the year were £8,862, against £7,938 in 1906. The total expenditure, exclusive of the amount set aside for depreciation, amounted to £3,867, or 2·45d. per unit sold, compared with £3,285, or 2·42d. per unit sold in 1906. Owing to the advance in the price of coal, which amounted to as much as 2s. 8d. per ton, the coal costs per unit sold show a small increase. The repairs and maintenance costs are also higher, this being due to a somewhat heavy outlay upon the overhauling of house meters, battery and plant. The balance to the credit of the net revenue account, after deducting debenture interest and the interim dividends on the preference shares, is £2,521. The directors recommend payment of the final dividend on the preference shares £375; a dividend on the ordinary shares at 5 per cent. per annum, £1,667; leaving £479 to be carried forward. The expenditure during the year on capital account was £1,614, for which, mains extensions, new services and meters were chiefly responsible. £1,900 has been set aside for depreciation, which the directors regard as an adequate provision. The depreciation fund now amounts to £15,370. There are now 1,047 consumers (increase 80) with 33,042 lamps. The units sold were 378,533. The annual meeting was held at Harrow on March 26th.

Underground Electric Railways Co. of London, Ltd.

In the financial papers for April 15th and 16th, will be found a good many details concerning the proposals for financial readjustment in this concern. It was stated that the directors, having considered the best means of meeting the company's financial requirements, and for dealing with its 5 per cent. profit-sharing secured notes, which mature on June 1st, 1908, have, in consultation with Messrs. Speyer and with advisory committees in London and Amsterdam, formulated a scheme of readjustment. The directors ask and recommend the noteholders and shareholders to adopt the scheme as approved by the committees, for which it is proposed, as soon as possible, to apply for the sanction of the court. The main features of this scheme are summarised as follows in the *Financial News*:—The company will deposit and pledge an additional £3,500,000 (nominal) tube shares and the equity of the power house with the London and Westminster Bank, Ltd., the trustee for the noteholders, and issue as detailed as follows:—£1,000,000 prior lien 5 per cent. bonds, due November 1st, 1920, for cash requirements; £3,000,000 4½ per cent. bonds, due January 1st, 1933; £5,200,000 6 per cent. income bonds, due January 1st, 1948. The noteholders are asked to exchange their notes as to 40 per cent. nominal value into 4½ per cent. bonds and as to 70 per cent. nominal value into income bonds, at par, the exchange taking place as on December 1st, 1907.

In connection with the same matter on 15th inst., Mr. Henry Terrell, K.C., appeared before Mr. Justice Warrington in the Chancery Division, and asked for the appointment of a receiver and manager in the matter of the Underground Electric Railways Co. of London, Ltd., in the action between Messrs. Speyer Bros., on behalf of themselves and all other persons holding secured temporary loan notes and profit-sharing secured notes of the defendant company, as plaintiffs, and the company and the London and Westminster Bank defendants. Proceedings by a creditor were threatened, and if these were taken the work of the power house might be stopped, and consequently the railways would be stopped, and the result would be a very serious position. The company had a scheme whereby it was intended to raise by prior lien debentures all the moneys necessary for the cash requirements of the defendant company, and also to pay off the temporary loan notes, and to enable the company to carry on its business on a sound basis. But in the meantime, and pending the carrying out of the scheme, it was essential that a receiver and manager should be appointed in order that, in the interests of everybody, there should be no possibility of any stoppage of any part of this great undertaking. They proposed that Sir George Gibb, vice-chairman and managing director of the company, should be appointed receiver and manager.

His Lordship granted an order appointing Sir George Gibb, on behalf of the holders of the profit-sharing secured notes, as receiver of assets comprised in the trust deed, and on behalf of the secured temporary loan notes as receiver of the company generally, and as manager of the company.

Telegraphic dispatches received in London from New York on Wednesday, state that Messrs. Speyer have announced definitely that there will be two public issues—one of 15 million dollars 4½ per cent. bonds, and another of 26 million dollars in 6 per cent. bonds. The present holders of notes will exchange them for portions of these issues, receiving for each 1,000 dols. note an average of 1,100 dols. in the new bonds. There will also be an additional issue of 5 million dollars prior lien 5 per cent. bonds.

Babcock & Wilcox, Ltd.

The directors' report for 1907 shows a net profit of £309,769, plus £25,895 brought forward. After deducting interim dividends paid in October of 3 per cent. on the preference and 8 per cent. on the ordinary shares (£69,400) £266,264 remains, from which the following dividends are to be paid for the half-year ending December, 1907:—3 per cent. on the preference shares (from which income-tax is to be deducted), £3,000; 8 per cent. on the ordinary shares (free of income-tax), £66,400; bonus of 4 per cent. on the ordinary shares (free of income-tax), £33,200, placing to the reserve fund £100,000, and to the dividend equilisation fund £25,000, leaving £38,664 to be carried forward. The extensions of the works referred to in last year's report have been completed and are in working order, and have enabled the increase in the business during last year to be dealt with. The volume of orders on hand at December 31st, 1907, and carried over for execution in 1908, is considerable.

Wolverhampton and District Electric Tramways Co., Ltd.

—The report for 1907 states that the total revenue amounted to £25,125. After deducting all expenses chargeable thereto, including debenture interest, repairs and maintenance, and providing £1,000 for the renewals fund, there remains a profit of £2,622, plus £543 brought forward. The directors recommend that there be placed to depreciation and reserve fund £500; to the payment of a dividend at the rate of 1½ per cent. per annum on the ordinary shares, £2,397; carrying forward £268. In view of the fact that £9,086 will be received from the Dudley Corporation as the purchase price of the tramways in Dudley, hereafter to be leased to the company, the directors have not thought it necessary to set aside any amount to sinking fund in this account. The capital outlay amounted to £1,135, and was chiefly in respect of the equipment of rolling stock with the Lorain equipment to enable the through services into Wolverhampton to be effected. The company have continued to benefit during the past year from the operation of their tramways as part of the system worked by the Birmingham and Midland Tramways Joint Committee. An agreement has been entered into with the other companies of the Joint Committee for providing a central car-shed and repair shop at Tividale for the execution of repairs, &c., on the basis of each company paying a rent proportionate to the number of cars owned on January 1st, 1907. The number of miles open was the same as in the preceding year. There were 4,381,837 passengers carried, against 4,102,374; the average receipts per passenger were 1·36d., against 1·3d.; the average working expenditure per passenger, ·93d., against ·89d.; and the proportion of expenses to receipts 68 per cent. against 64 per cent.

Oldham, Ashton and Hyde Electric Tramway, Ltd.

—The report for 1907 states that the directors have had under consideration the question of making provision for the cost of renewals other than those ordinarily charged against the year's revenue, and have accordingly debited the profit and loss account with £1,716, to be placed to a provision for renewals account. The total revenue for the year was £33,296 and the expenditure £26,547, leaving a profit of £6,749, plus £494 brought forward. There is to be set aside for forming a cumulative sinking fund for redemption of outstanding debentures, £500; the depreciation and reserve account is brought up to £13,500; a dividend on the ordinary shares at the rate of 7 per cent. per annum, making 6 per cent. for the year, is to be paid, leaving £243 to carry forward. During the past year £898 has been expended on capital account. The company has joined the British Electrical Federation, Ltd. The directors report the death of Alderman Thomas Heginbottom, J.P.

Primitiva Gas and Electric Lighting Co. of Buenos Ayres, Ltd.

—The report for 1907 states that the balance of revenue account and the interest received from the German Transatlantic Electricity Co. amount to £105,348, plus £16,612 brought forward. The directors recommend a final dividend of 4s. 6d. per share (free of income-tax), making a total distribution of 7 per cent. for the year on the ordinary shares, and leaving £15,881 to carry forward.

Bromley Electric Light and Power Co., Ltd.—

This company's annual meeting was held at Bromley on 6th inst., Mr. F. E. Gripper presiding. The report, which recommended a final dividend making 5½ per cent. for the year on the ordinary shares, was adopted.

Colombo Electric Tramways and Lighting Co., Ltd.

—The meeting of this company was held in London on Wednesday. The report of the directors then submitted recommended a dividend of 4 per cent. (8s. per share), free of income-tax, for the year, placing £5,111 to reserve and renewal fund, from which £13,000 was taken to write down the track renewal account, and £1,000 to extinguish the mains and plant improvement account, carrying forward £935.

Marconi's Wireless Telegraph Co.

—The annual meeting will be held on April 30th. The directors' report to September 30th last was published in full in the *Times* of yesterday. Among other things, it recommends an increase in the capital of the company to £750,000, by the creation of £250,000 7 per cent. fixed cumulative preference shares, with further dividend rights after 10 per cent. is paid on the ordinary, the new issue being made to pay off engagements to bankers and others. We shall refer to the report at length in our next issue.

Oriental Telephone and Electric Co., Ltd.

THE directors' report for 1907 shows that including £1,036 brought forward, and after deducting the interim dividends of 3 per cent., paid November 1st last on both the preference and ordinary shares, and making the necessary provision for redemption of the debenture stock and other charges, there remains to be dealt with £15,839. Out of this is paid a final dividend of 3 per cent. (less income-tax) for the year on the preference shares, requiring £1,500, and a final dividend of 5 per cent. (free of income-tax) on the ordinary shares, making 8 per cent. for the year, absorbing £8,966, while £3,500 is transferred to reserve account, leaving £1,873 to carry forward. The directors record the death of the chairman, Sir Auckland Colvin, who occupied that position for ten years. There was issued in June £50,000 4 per cent. redeemable debenture stock (part of an authorised issue of £200,000), partly for the requirements of the company's own exchanges, and partly to assist the subsidiary companies.

The changes in the company's own systems by means of underground cabling have now been completed, but extensions to the scheme as originally laid out have become necessary. The increased business anticipated in last year's report, as a consequence of these important alterations, has made itself felt, and all the chief exchanges show an improvement for the year.

At Rangoon, land had to be purchased for a new sub-exchange, which has since been constructed, and is now in working order.

In Mauritius, the Government has under consideration a scheme whereby it is hoped that the scope of the company's business will be extended to the whole of the island.

The Indian local companies have declared the same dividends as for the year 1906, viz., the Bengal Telephone Co., Ltd., 5 per cent., and the Bombay Telephone Co., Ltd., 6 per cent., and the amounts have been included in the revenue account.

The Telephone Co. of Egypt, Ltd., has declared a dividend of 10 per cent. for the year on both its preferred and deferred shares, which has also been brought into the accounts. That company is engaged on further extensions as well as on work connected with adapting the freehold premises it purchased in Cairo, in March, 1907, to the company's requirements. The telephone trunk lines between Cairo and Alexandria, and Cairo and Tantah, continue to be well patronised by the public and by that company's exchange subscribers. Installations of additional provincial telephone lines for the Government of H.H. The Khedive are still in progress, and it is anticipated that this branch of the company's business will take still further extensions. The Ministry of Public Works in Egypt granted to that company last year an authorisation for the installation of telephone lines in the province of Fayoum, in Upper Egypt, for a period of 35 years from December 17th, 1907; work in connection with it is now in progress. To provide the means to carry out these contracts, the directors, on behalf of this company, have taken up a further 8,000 preferred shares of £5 each in the Telephone Co. of Egypt, Ltd.

The China and Japan Telephone and Electric Co., Ltd., at Hong Kong and Kowloon have also had a prosperous year subsequent to the reconstruction of their system, and propose to declare a first dividend shortly on their ordinary shares.

Calcutta Tramways Co., Ltd.

THE meeting was held on Tuesday at 1, Queen Victoria Street, Mr. E. C. Morgan presiding.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, April 10th, page 631), after referring in terms of deep regret to the great loss the company had sustained by the death of Sir Howard Vincent, who had been a member of the board for 22 years, said that the report explained at some length the figures of the accounts, but it was the wish of the directors to give the fullest details of the causes which had led to the large increase which had taken place in the expenditure. To do this adequately, it was necessary to consider how far it had arisen from circumstances beyond the control of the directors; and how far those circumstances had contributed to the reduction in the amount available for distribution as dividend. The capital account showed that very large sums of money (£145,408) had been expended upon the works rendered necessary for extensions in progress during the year. From this sum there had been practically no return, by reason of the delays which had occurred in getting the new lines into operation. Some six miles of line was actually completed, and only needed a few formalities to become immediately operative and revenue earning. This important addition to their system might be expected to contribute to their earnings by May 1st; they had a reasonable expectation that this would have been the case much earlier. Small lengths of the extensions were brought into operation during the year, but only for short periods, so that they derived comparatively little benefit from them, especially as they only constituted fragments of longer lines. This indicated clearly the heavy handicap they had encountered by the paralysis of so large a sum of capital expenditure, and this had been increased by the expenditure during 1906 for additions to their power and rolling stock, which had only become partially remunerative. In spite of these difficulties which had retarded the natural growth of the system, they had succeeded in obtaining receipts amounting to £167,378, or £8,521 more than was realised in 1906, and about double the amount earned in 1902, when electric traction was first brought into operation. The tendency of the traffic had been towards continued growth, and there was every reason to believe that a further impulse would be given to it as soon as their new lines became operative. Unfortunately, as far as last year was concerned, their increased receipts were more than counterbalanced by heavy expenditure, which became necessary to obtain from their old system the larger receipts. The power expenses were higher by £2,024. This was partly due to fuel, which had cost them more by reason of the higher price they had to pay for coal, and would have been greater had not great economy been made in its use. The main increase, however, had been owing to the maintenance and repairs to their plant rendered necessary by the severe strain placed on their D.C. engines in order to obtain the increased traffic receipts. Traffic expenses were higher by £1,710, which was not excessive having regard to the additional staff needed to secure efficiency in control. Maintenance and repairs showed the heavy increase of £7,134, which was mainly due to cars and their electrical equipment. They had an additional 50 cars in commission, which accounted in a measure for the increased charge, but the main reason for this heavy increase in expenditure was the fact that they had been unable, for want of space, to deal efficiently and economically with the maintenance and upkeep of the cars. This was largely owing to circumstances beyond their control. They did not lose sight of the necessity, when increasing the number of cars, for providing accommodation for them, and they applied for and obtained sanction for a length of line to a place called Beliaghatta, which was a convenient spot for the erection of an additional car-shed. They made all their arrangements accordingly, and had all in readiness for the completion of their new line and shed, and only awaited the actual signing of the contract, when they were informed that the director of two of the Government railroads, which had their termini on either side of the road through which their line was to pass, had made arrangements for joining these termini, and that the road through which their line was to run was to be closed, and that they could not be allowed to proceed. This placed them in the position of being without proper housing space for their additional cars. They were, therefore, compelled to make use of their repair shops at the central station for this purpose. This, and defects which were discovered in some of their new cars, prevented them from previously giving the necessary timely repairs to their cars in service, throwing excess of expenditure on the past year. After much difficulty they had succeeded in acquiring a site for the erection of a shed to house 60 trains, or 120 cars, and when this had been completed they hoped that much of their difficulty under this head would disappear. General expenses showed an increase of £6,418, some £1,200 of which was increased income-tax, due, of course, to their increased profits, and of the balance about £4,100 was under the head of track rent. This was, for the most part, a non-recurrent item. They would remember that when they obtained their concession, it was stipulated that the track rent was to be Rs. 35,000 per annum for the existing system. A discussion arose with the Corporation as to what was the "existing system." It was obvious that certain alterations in the lines to render the system workable by electricity were necessary, but it was a long time before they could arrive at an agreement on this point. However, matters were finally settled, and then came the question of additional lines which, in terms of the concession, were to pay track rent at a rate to be agreed between the Corporation and the company. The demands of the Corporation were at first such as they could not possibly agree to, and lengthy negotiations were carried on as to the rate they were to pay. Finally it was agreed that the rate to be paid was to be Rs. 4,000 annually per mile of double line within the city and Rs. 1,000 annually in the suburbs. Whilst these negotiations were proceeding, no payments were made for the extra lines, and it was not till 1907 that the actual payment was made, and it was this which had so swollen the amount now shown in the accounts. No further provision had been made this year for the depreciation fund, as so large an amount had been paid for maintenance, and the present amount of the fund stood at £48,080 separately invested. Regarding those lines for which concessions had been granted, but upon which no work had yet been done, the most important was that to the north, which they had called in previous reports the Barnagore line. This has been the subject of negotiation for about three years, and was entertained by them at the urgent request of the residents of the Cossipore Chitpore Municipality, the authority through whose area the line was to pass. After much negotiation matters were finally arranged with the municipality who desired the work to be carried out immediately, but when they were about to commence they were informed that it was necessary to have the assent of the Government of India. A Committee was appointed on their behalf to consider the question, who, by a majority, came to the conclusion that the roads selected were not of sufficient width to carry their lines, and that permission could only be granted if the width of the road was increased to 40 ft. They could not agree to bear the expense of this improvement, as they had repeatedly stated in cases of similar demands from local authorities, that all they could undertake would be to lay down lines, and not to make roads on which they should be laid. The matter, therefore, was hung up for the present, but as this was the only outlet from Calcutta to the North, it was possible that in view of the requirements of the Calcutta Improvement Scheme, which was framed with the object of relieving the congested areas within the city limits, the authorities must before long adopt a more reasonable attitude. The other line was one in Howrah, which did not press, and was not undertaken at present by reason of alterations and strengthening being needed on a bridge over which their cars must pass. During the year under review there had been certain untoward incidents which had operated prejudicially to their business. It was a matter of common knowledge that a severe and widespread strike took place amongst the employés of the East Indian Railway. This interfered with the ordinary service on the railways and prevented the usual flow of passengers into Calcutta, and was reflected upon the volume of their traffic. It also made the carriage of goods upon the railway difficult, and prevented them from obtaining their supplies of coal with the ease and regularity which ordinarily obtained. There had also been at times disturbances within the city, and although they had not suffered specifically from the results of these disturbances, they had no doubt operated against the usual inflow of country visitors, who feared they might be interfered with and consequently stayed away. The number of their riders had thus been to some extent curtailed, and their holiday traffics did not reach the figures which might have been expected. As regarded the incidents especially affecting their industry, one of the most important had been the obtaining from the Corporation,

after a somewhat acrimonious discussion in their Council chamber, of permission to alter their method of running in accordance with that adopted almost universally elsewhere by having fixed stopping places for the cars. When the electric service was opened, they adopted the plan up to that time in use on the horse-cars, and stopped their cars at the request of any individual without regard to the general convenience. This system was open to great abuse, and frequently the cars were stopped every few yards, which, when a quick service was being carried on, led to serious blockages of the cars, and rendered it almost impossible to maintain a service with anything approaching to regular intervals. This led to complaints from the public, who resented the delays which were thus created. In order to remedy this they applied to the Corporation to alter the by-law, which compelled them to stop at the will of any passenger under heavy penalties. This salutary change was contested, and much time was lost before the alteration was made. It would now, however, be possible to render their service much more regular and convenient to the public, and they would also in a measure be able to obviate the overcrowding of the cars, which had been the subject of complaint, and which under the old system they were powerless to prevent.

Sir H. Kimber, Bart., M.P., seconded the motion.

The Chairman, in reply to questions, said it was impossible to say exactly what the track rent would be in the future, because the rates varied; but it would be somewhere about £3,600 a year. As regarded maintenance charges, he was in hopes they would be considerably reduced, especially as regarded their relation to the receipts, when the latter assumed a normal figure.

The report was then adopted.

Mr. A. J. J. Pfeiffer, the general manager in India, at the request of the chairman, made a short statement relative to the position and prospects of the company. He was, he said, perfectly certain that the business in Calcutta was a thoroughly stable and growing one. He expected to go on increasing in the old system, and when the new systems were opened at Howrah and elsewhere he did not think there would be any cause for dissatisfaction.

Bath Electric Tramways Co., Ltd.

An extraordinary general meeting of the above company was held on Tuesday last week at Winchester House, E.C., under the chairmanship of Sir Vincent Caillard, for the purpose of altering the articles of association, so as to comply with the regulations of the London Stock Exchange. The Chairman explained that the alterations had reference to the disclosure of any contract in which a director might be interested. The necessary resolution was agreed to.

The ordinary general meeting was afterwards held, and in moving the adoption of the report (see Electrical Review, April 17th, page 672), the Chairman said that on the assets side of the balance-sheet the first item calling for attention was the additions to plant, machinery, &c., £1,284, which was due to small improvements which could not be charged to revenue. This accounted for half the expenditure, while the other half was due to strong V brakes for motor-omnibuses. The stock of tools, spare plant and coal, £6,010, was always a variable figure, and the increase was due to the increased price of coal and to their having stocked materials for special repairs to motor-cars, which would become necessary shortly after the close of the year. On the other side of the accounts, the loans secured by mortgage and on the company's debentures now stood at £28,300, and had increased by £4,000 or £5.000. It arose from the fact that capital expenditure was incurred in the previous year, and last year they had to foot the bill. Since the beginning of the year they had managed to reduce that loan account to some extent. The interest on the loan was naturally increased by the larger loan, and also from the high rate of interest which ruled last year. With regard to the revenue account, the power expenses were £3,595, which was an increase of about £400, and was accounted for partly by the increase in the price of coal and by the replacement of an entire set of field coils for those burnt out on one generator. Their plant was in an excellent condition, and the general manager said it was as good as when they commenced running. In operating expenses there was an apparent decrease of about £1,100, and in repairs and renewals an apparent increase of £1,400. As a matter of fact, they used to charge items to operating expenses, which were more properly chargeable to renewals. If the two items were taken together and compared with the previous year, they showed an increase of £283, due almost entirely to the increased cost of petrol for the motor-'buses. Management expenses showed an increase of £200, but this again was only apparent, for really there had been an economy under that heading. In 1906 the capital account was charged with its proper proportion of management expenses, amounting to about £550. Last year they were unable to proceed with any capital expenditure to which management expenses could be charged, and so they had to charge it all to revenue. There was, however, really an economy of £350 under that head. Rent, rates, taxes and insurance showed a saving of about £280. In parcels there had been an increase of £100, due to their having to hire premises to deal with that traffic. There was a saving of £177 in administration expenses, and taking all the items together, there was a saving of roughly about £550. On the other side of the account, traffic and parcel receipts amounted to £41,452, against £42 722 in the previous year, or a decrease of £1,270. This was due entirely to the weather, which in its wet moods seemed to have a special predilection for moistening the hills of Bath. It was not due to any defect in the management. There was a net decrease of £1,526, and looking at all the disadvantages they had suffered from, owing to the bad weather, the increase in the price of petrol and coal, &c., he did not think it was really an unsatisfactory result. The chairman proceeded to quote the falling off in the passenger traffics of the railways operating in the south of England, and said that their company had carried 286,000 fewer passengers. Their car-mile receipts had decreased ·115d., but it was satisfactory to note that their receipts per passenger had steadily increased since they commenced operating. Last year it was 1·447d., as against 1 463d. in the preceding year. As they knew, part of their system was constructed and worked under a Light Railway Order, which meant that the fares which they could charge were fixed, and in practice they had been found absolutely unremunerative. This was a disadvantage not only to the shareholders of the company, but also to the general public, for no system could be carried on at the highest level of efficiency if part of the system was carried on at a loss. After careful consideration they had decided to apply to the Board of Trade for permission to vary their fares. First this had to be approved by the local authorities, and they had received the assent of the Bath Rural District Council, and were now awaiting the decision of the Bath Corporation. In the absence of any opposition from these two bodies, they hoped the Board of Trade would not refuse their application. After the payment of debenture interest, and the dividend on the preference shares, there was an available balance of £2,489, which the board recommended should be carried forward. It was true that they had sufficient to pay a dividend of 3 per cent., but that would mean dividing up to the hilt, and seeing that they had a reserve fund of only £2,000 and a depreciation fund of £2,000 they did not think this was wise. It was a question whether the depreciation fund should not be increased, but they kept their system in a perfect state out of revenue, and further, they were commencing a depreciation fund by the debenture sinking fund which started in 1908 at the rate of £1,000 a year. In conclusion, the Chairman said that although the past year had not been a good one the board were not despondent, for they were convinced that the system was a good sound, well-managed one, and that those who had placed their money in it would in the course of years have nothing to regret.

Mr. A. A. Campbell Swinton seconded the motion.

Mr. Hunter said it was gratifying to hear that there was a likelihood of the fares being increased. He would have liked to have known whether the motors were worked at a profit, and also if the parcels service was paying? Two years ago he urged that they should use more discretion in expenditure on capital account. By force of circumstances, last year they had to suspend their expenditure on capital, but they were told they had had to charge certain expenses to revenue, which would have been charged to capital. What he wished to know was why any expenditure of the kind was incurred at all? He admitted they had good engineers, but did they want them? They might keep their engineers, but should convert them into traffic managers, for they had the reputation of paying more on their system than was paid on any other traction system in the United Kingdom.

Mr. Crisp suggested that the present was a good opportunity for calling the different classes of shareholders into line, with a view to the consolidation of the company's share capital.

The Chairman said that last year something of the same kind of suggestion was made, and it was stated that if the deferred shareholders would come forward they would consider a scheme, but nothing was brought forward. He would be delighted to hear from Mr. Crisp further with regard to that matter. It was a most difficult thing to show what influence on the receipts of the whole system the motor-'buses had, but they would try and get in the future an approximate idea of the result of the motor service. The parcels system was conducted at a profit. It was exceedingly difficult in a small system to make the expenditure correspond to traffics.

The report was then adopted.

Cuba Submarine Telegraph Co., Ltd.

The meeting of this company was held on April 15th at the offices, 58, Old Broad Street, E.C., under the chairmanship of Mr. C. W. Parish.

In moving the adoption of the report (see Electrical Review, April 10th, page 631), the Chairman said that in looking back on the records of the two last general meetings, one of which was held at that time last year and the other in October, he found that in each case he had to explain that their profits had been influenced by some unexpected occurrences. In the first case their traffic had been increased by the political rising in the island, which led to American intervention, and in the following half-year came the earthquake in Jamaica, which brought a heavy addition to the Press and private messages from the West Indies. During the half-year from July to December with which they were now dealing, nothing unusual of any importance had happened. The cables had worked well, and they had had a satisfactory traffic which they had been able to deal with quickly and, he believed, most accurately. In making comparisons between this half and the same period of last year, they must take into consideration the exceptional traffic in 1906, to which he had referred. In 1906 they had as revenue £18,458 for traffic, and £1,549 as interest, making a total of £20,007. This half they had £15,521 for traffic, and £1,957 for interest, making altogether £17,478, or a reduction of £2,529. It would be noticed that their traffic was less, whilst their interest

was greater, and this was owing to the high rates they were able to earn on their cash balances deposited with the bank. Their expenses in 1906 were £6,573, while in the present half-year they were £6,177, or £336 less. This reduction generally resulted from the maintenance and repairs to cables having been rather less, and also there was a reduction in the overtime worked by their local staff. But as he had mentioned on previous occasions they found very little variation in their expenses. Every item thereof was carefully watched and adjusted, and he could safely assure them that there was neither waste nor extravagance. Deducting their expenses of £6,178 from their gross receipts of £17,478, they had £11,300 to deal with. They had placed £3,000 to reserve, and were able to propose the usual dividend at the rate of 10 per cent. per annum on the £60,000 preference shares, and of 6 per cent. per annum on their £160,000 ordinary share capital, thus maintaining the same rate as they paid in October. He was sure this was a result which would be satisfactory, as the balance carried forward was somewhat increased. So far as they had progressed in the present year, everything had gone along quietly, much on the same lines as heretofore, but he ought to mention that there had been rather a set-back in the whole island. Unfortunately the sugar crop had been a very short one, and this was the most important point in the prosperity of Cuba. The American intervention had continued, but, generally speaking, there had not been lately those bounds of progress which might be expected in an island so bountifully treated by nature as Cuba. However, as the price of Cuba sugar was fairly satisfactory, he expected planters would make a great effort to secure a heavier crop next year. In reference to their claims against the United States and the Spanish Governments, he could only report that they were still pursuing them, and hoped they would yet be successful in obtaining compensation, which was so clearly due to them. It was not a very amusing part of their work, but he could assure them that the board would keep the matter before them, and push on with the claims. In conclusion, the Chairman stated that it was the intention of the board at the next meeting to bring resolutions forward for the alteration of the articles of association. The company had been working for 38 years, and they desired to bring their articles into line with the several Acts which had recently been passed.

Mr. Geo. Keith seconded the motion, which was carried.

In proposing a vote of thanks to the board—which was carried—Mr. Geo. Lyddon congratulated the directors on paying the shareholders 1 per cent. more than they paid in the corresponding half-year.

British Aluminium Co., Ltd.

The directors' report shows that the profit for 1907 transferred to appropriation account is £120,482. There has to be deducted for debenture stock and debenture interest £28,515, the expenses of issue of new capital in 1907 amounting to £7,227 have been written off, and there has been appropriated in reduction of the cost of the company's temporary factory at Kinlochleven £10,764. The last-named two sums, amounting together to £17,992, have been applied in accordance with the debenture stock supplemental trust deed, in purchasing and cancelling debenture stock. There thus remains available £73,975 of which it is proposed to write off for depreciation £20,000 leaving £53,975, to which sum has to be added the balance from the previous year £34,549, making a total available profit of £88,524. Of this sum there has been appropriated in the payment of—

Dividend on "A" 6 per cent. preference shares for 1907, £6,000: interim dividend on 7 per cent. preference shares for half-year to June 30th, 1907, £7,000; interest on 4 per cent. funding certificates for half-year to June 30th, 1907, £1,290; interest at 5 per cent. per annum on amounts paid up on conversion shares for half-year to June 30th, 1907, £1,494; interim dividend at the rate of 7 per cent. on ordinary shares for half-year to June 30th, 1907, £7,000.

The board now proposes to pay—

Final dividend on 7 per cent. preference shares, £7,000; balance of interest on funding certificates for the year, £1,288; interest at 5 per cent. on amounts paid up on conversion shares for half-year to December, £3,500; interest at 5 per cent. per annum on amounts paid up on 1908 conversion shares to December, £1,463; final dividend at the rate of 7 per cent. on ordinary shares, £7,000.

There then remains £45,489, of which there has been utilised in purchasing and cancelling 2,196 funding certificates of £5 each at cost, £8,986, leaving £36,503 to be carried forward. In comparison with 1906 there has been a decline in the profits, which during the preceding five years had shown continuous expansion. This may be attributed to the slump in copper last July, and to the resulting demoralisation in the metal markets generally. Not only did prices decline sharply, but there was a severe contraction in the demand for all metals for several months subsequently. There has been no recovery in the price of aluminium, so the metal has been taken into stock at a much lower price than in previous years. Customers, however, have latterly been ordering much more freely, and an improving demand may now be counted on. The temporary aluminium works at Leven only commenced producing during the last week of December, and those at Stangfjord in January last, so that the company derived no advantage from them during the year. Progress continues to be made with the development of the permanent power scheme at Kinlochleven, but the board is much disappointed at having to state that there is now no prospect of any power being derived from this prior to the summer of next year, when the various sections of the work should be completed to enable the production of aluminium to be started. The erection of the village of Kinlochleven has been much advanced. The development of the Orsières power scheme is being proceeded with, and a contract has been entered into for the construction of the first portions of the hydraulic section of the works. The construction of the Martigny-Orsières Railway, which was commenced last year, is proceeding satisfactorily. The first 8 kilometres are well in hand, and will shortly be ready for the rails to be laid. The next six are just being begun; and the company, having undertaken to complete the line, will proceed with the remaining 6 kilometres as soon as the detailed plans have received the Government's approval. Towards meeting the large capital expenditure which these extensions entails, issues having been made of 40,000 "1908" conversion shares of £10 each, 39,070 of which have been subscribed, and of 20,000 "A" 6 per cent. preference shares of £5 each, all of which have been taken up.

Mr. A. J. Sharwood has been elected a director of the company.

City of Birmingham Tramways Co., Ltd.—The report for 1907 states that the revenue account, after providing £12,000 for the year's interest on debentures and £12,083, the dividend on the preference shares, shows a surplus of £35,772. After deducting £2,104, the interim dividend at the rate of 5 per cent. per annum paid on the ordinary shares, there is a balance of £33,667. A dividend on the ordinary shares at the rate of 5 per cent. per annum for the six months ended December 31st last is recommended, together with a bonus of 5 per cent., making 10 per cent. for the year; transferring £27,353 to reserve fund, which is thus increased to £459,121. Expenditure on capital account during the year was £8,696, and includes part of the cost of reconstructing the Stratford Road tramways in Yardley for electric traction. £21,676 has been received from the sale of old rolling stock and of the overhead equipment and cables in Coventry Road and John Bright Street to the City of Birmingham, and credited to capital account. The traffic receipts, compared with the previous year, show a reduction of £131,000, due to the termination on December 31st, 1906, of the leases of the steam tramways in Birmingham and the sale as at that date of certain of the tramways in King's Norton and Handsworth. The shrinkage in the receipts has been slightly less than was anticipated. The expenses have been proportionately reduced, and £12,200 less was paid for rental of lines than in the previous year. The working of the company's undertaking by the Birmingham and Midland Tramways Joint Committee continues to show satisfactory results, and the arrangement has been further continued. Owing to the competition of the Corporation tramways, and the excessively heavy cost of repairs and maintenance of the motor-omnibuses, and the prevalence of bad weather, the result of the past year's working of the omnibuses has been very unsatisfactory. On October 5th last the motor-omnibuses were withdrawn from service. Negotiations are in progress with a view to disposing of the garage at Five Ways and the older types of motor-omnibuses and the better utilisation of the other vehicles.

The annual meeting was held yesterday in London.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to—

Charing Cross, West-End and City Electricity Supply Co., Ltd.—Provisional certificates (25 per cent. paid) for £301,630 4½ per cent. debenture stock.

R. & J. Dick, Ltd.—£25,000 6½ per cent. cumulative preference shares of £1 each, fully paid.

And to allow the following to be quoted in the Official List:—

Charing Cross, West-End and City Electricity Supply Co., Ltd.—£109,500 4½ per cent. debenture stock.

Manx Electric Railway Co., Ltd.—Further issue of 3,140 6½ per cent. cumulative preference shares of £5 each, fully paid.

Mexico Tramways Co.—$300,000 additional first mortgage 50-year 5 per cent. gold bonds.

Sao Paulo Tramway, Light and Power Co., Ltd.—6,000 additional shares of $100 each of capital stock.

Urban Electric Supply Co., Ltd.—Further issue of £75,000 4½ per cent. first mortgage debenture stock.

Western Union Telegraph Co.—The quarterly statement to March 31st last shows that the net traffic for the quarter ended December 31st, 1907, was $803,942, whereas the dividend of 1¼ per cent. in stock and interest on bonded debt amounted to $1,650,062, thus apparently showing a deficit of $846,120. The surplus, which was $14,923,200 at October 1st, 1907, stood at $14,077,080 at December 31st and at $13,514,018 at March 31st last, as there was a further call upon it to the latter date. The net traffic to March 31st is calculated at $1,100,000, and the dividend of 1¼ per cent. is again payable in stock. The unfavourable statement is ascribed to the effect of the commercial depression, which has been somewhat lessened by reduced expenditure. The balance of traffic, after deducting interest on bonded debt, leaves surplus revenue of $666,937, all of which, it is stated, has been used to pay indebtedness resulting from the recent extraordinary expenses.

American Telephone and Telegraph Co.: Correction.—In our extracts from the 1907 report of this company, published in our issue of April 10th, page 629, in the fourth paragraph we stated in error that it had become "necessary to pay substantially all of the dividend for 1907 out of surplus." This remark related to the Western Electric Co., in which, as was shown, the company has a very large holding; it in no way applies to the American Telephone and Telegraph Co.

Prospectus.—*The London Electrobus Co., Ltd.*—A prospectus is about to be issued—we have received an advance copy—inviting subscriptions for £240,000 £1 ordinary and 12,000 (5s) deferred shares, for the purpose of increasing the number of vehicles and providing necessary additional garage accommodation. Contracts for 125 vehicles have been entered into. An article illustrating the 'bus, &c, appeared in the Electrical Review for December 20th, 1907, and the statement made by the chairman at the last general meeting will be found in our issue of November 15th, 1907. The list will open on Monday and close on Thursday next.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Route miles open.	Inc.
Aberdeen	Apr. 15	2,437	— 23	46	62,209	— 1,362	14·4	..
Ayr	,, 18	488	— 2	49	13,747	— 126	.8	..
Bath	,, 15	1,295	— 700	15	8,703	— 1,363	13	..
Belfast	,, 17	7,189	+ 538	3	8,713	— 1,338	36	..
Birkenhead	,, 19	2,028	+ 158	3	2,775	+ 46	18·52	..
Birmingham Corp.	,, 11	12,659	+ 848	..	..	..	56·46	..
Blackburn	,, 15	2,027	+ 81	3	3,071	— 868	14·25	..
Blackpool Corp.	,, 16	1,104	—1,011	..	..	..	11·87	..
,, —Fleetw'd.	,, 18	871	+ 292	15	3,753	— 792	8·25	..
Bolton	,, 19	5,254	+1,208	3	6,903	+ 614	26	..
Bournemouth	,, 15	2,972	— 146	2½	3,213	— 1,267	21·5	..
Bradford	,, 11	8,589	—1,589	..	..	..	54·9	1
Brighton	,, 19	1,666	— 210	3	2,171	— 60	9·5	..
Bristol	,, 17	9,861	— 121	..	..	..	12·21	..
Brit. Elec. Trac. Co.								
Airdrie	,, 10	418	— 37	14	3,154	+ 60	3·65	..
Barnsley	,, 10	355	— 8	,,	2,342	+ 97	..	..
Barrow	,, 10	413	— 68	,,	3,051	— 62	5·37	..
Cavehill	,, 10	128	— 234	,,	883	— 174	..	..
Devonport	,, 10	878	— 107	,,	5,923	— 262	8·85	..
Gateshead	,, 10	1,976	— 82	,,	13,988	+ 183	11·25	..
Gravesend	,, 10	990	— 183	,,	2,651	— 464	6·5	..
Greenock	,, 10	977	— 533	,,	6,640	— 1,961	7·25	..
Hartlepool	,, 10	393	— 198	,,	2,998	— 562	6·72	..
Kidderminster	,, 10	173	— 131	,,	1,189	— 177	..	..
Leamington	,, 10	299	— 116	,,	1,863	— 82	3	..
Merthyr	,, 10	413	— 99	,,	2,763	— 106	2·9	..
Metropolitan	,, 10	10,195	— 89	,,	67,701	+11,061	22	..
Middleton	,, 10	652	— 288	,,	4,319	— 222	8·5	..
Mid. Joint Com'tee	,, 10	11,218	—2,430	,,	76,987	— 1,061	..	..
Oldham—Ashton	,, 10	1,160	— 236	,,	7,960	— 292	9·18	..
Peterborough	,, 10	219	— 116	,,	1,469	— 101	5·81	..
Potteries	,, 10	3 521	— 197	,,	26,087	+ 535	29	..
Rothesay	,, 10	123	— 431	,,	711	— 422	2·75	..
Southport	,, 10	451	— 311	,,	2,829	— 518	8·17	..
S. Metropolitan	,, 10	1,396	— 418	,,	9,238	— 672	..	..
Swansea	,, 10	1,820	— 55	,,	11,928	+ 587	5·5	..
Tynemouth	,, 10	260	— 229	,,	1,991	— 371	3·75	..
West n-s-Mare	,, 8	62	— 225	,,	353	— 229	3	..
‡Worcester	,, 10	495	— 148	,,	3,308	— 152	5·75	..
Wrexham	,, 10	209	— 30	,,	1,278	— 74	..	..
Yorks. Wool. Dist.	,, 10	1,802	— 450	,,	12,185	— 829	17	..
Miscellaneous	,, 10	355	— 161	,,	2,560	— 229	..	..
†Burnley	,, 11	1,177	+ 59	..	..	..	7·5	..
Burton-on-Trent	,, 19	512	— 4	3	702	— 6	11	2
†Bury	Mar. 22	1,017	+ 102	..	..	..	10·5	..
†Cardiff	Apr. 4	2,012	— 438	..	..	..	..	..
†Carlisle	,, 11	156	— 5	15	2,231	+ 27	..	..
†Chatham and Dist.	,, 9	641	— 25	14	8,585	— 8·6	12·21	..
Cork	,, 16	833	— 5	15	5,988	— 478	9·89	..
†Croydon	,, 10	1,219	+ 29	..	..	..	12	·75
Darlington	,, 18	377	+ 10	3	572	— 47	..	..
Darwen	,, 17	550	+ 73	..	..	..	4·36	..
Dover	,, 11	279	— 192	..	..	..	4·75	..
Dublin	,, 17	9,614	— 566	..	72,925	+ 381	54·25	5·5
Dundee	,, 15	2,231	— 27	48	54,650	+ 2,173	14·5	..
East Ham	,, 18	1,710	— 56	3	2,202	— 173	7·75	..
Glasgow	,, 18	34 965	+ 850	47½	798,708	+17,011	89·25	5·5
Hastings	,, 16	1,650	— 220	..	..	..	..	..
Huddersfield	Mar. 21	2,874	— 39	51	79,591	+ 3,269	..	..
Hull	Apr. 18	4,854	+ 444	3	6,431	— 366	18	..
Ilkeston	,, 15	262	+ 19	3	382	— 57	3·5	..
Ipswich	,, 11	449	— 121	..	..	..	10·5	..
†Kilmarnock	,, 11	143	— 7	47	7,343	— 214	4·25	..
Lan'kshire Trm Co.	,, 16	2,522	+ 214	15	18,762	+ 2,491	15·82	8·26
Lancashire United	,, 15	2,981	+ 254	15	17,429	— 94	99	1
Leeds	,, 11	12,868	—1,518	..	..	..	96	6·5
†Leicester	,, 11	2,120	+ 4	..	..	..	..	..
Leith	,, 11	975	— 41	47½	24,350	+ 128	6	..
†Liverpool	,, 4	10,801	— 996	14	140,616	— 2,944	104	..
‡L.C.C.	,, 4	62,904	—1,181	52	1,643,754	+49,780	116½	1·5
London United	,, 18	12,069	+1,079	..	82,789	— 3,980	..	..
Lowestoft	,, 18	307	+ 29	29	4,487	+ 71	3·5	..
Manchester	,, 18	23,682	+2,340	3	38,600	+ 2,214	86	11
Newcastle	,, 11	7,430	—1,288	..	..	..	..	..
Newport	,, 11	1,234	— 167	..	..	..	14·5	..
Northampton	,, 17	771	+ 43	2½	952	— 246	5·5	..
†Oldham	,, 12	1 864	+ 134	3	5,208	— 1,014	23·75	..
Pontypridd	,, 11	668	+ 5	..	..	..	5	1·75
†Portsmouth	,, 11	1,656	+ 7	..	..	..	14·5	..
†Preston	,, 8	687	+ 22	..	..	..	..	..
Reading	,, 16	1,026	— 14	2½	1,279	— 23	13·25	..
Rotherham	,, 16	1,171	+ 142	2½	1,988	— 244	10	·66
Salford	,, 13	8,803	—2,028	..	..	..	38·9	..
†Sheffield	,, 12	5,448	+ 394	2½	13,035	— 2,227	35·75	..
Southampton	,, 1	..	..	52	52,648	+ 3,463	..	..
Southend-on-Sea	,, 15	582	..	3	621	— 227	..	..
Sunderland	,, 19	2,301	— 157	3	3,107	— 903	..	..
†Swindon	,, 8	138	— 12	..	..	..	4·4	..
†Tyneside	,, 8	339	— 52	15	4,909	— 1,077	8·87	..
Wallasey	,, 18	1,605	+ 167	2½	2,103	— 272	8·72	·22
Walthamstow	,, 18	1,191	+ 239	3	1,496	..	9	..
West Ham	,, 16	4,147	— 154	3	6,283	— 1,230	14·7	..
Wolverhampton	,, 15	1,511	— 9	..	..	..	13·5	..
Baker St.-Waterloo	,, 18	5,700	+ 840	16	48,965	+11,614	4·25	1
Cen. London Rly.	,, 18	10 918	—1,455	16	96,846	— 3,245	5·77	..
Char. +, Eus. Hamp.	,, 18	6 290	..	16	50,400	..	7·75	..
City & S. Lon. Rly.	,, 19	5,998	— 174	16	53,037	+ 5,618	7·3	1·05
Dublin-Lucan Rly.	,, 18	286	+ 34	16	1,505	— 20	7	..
G.N. and City Rly.	,, 18	3.185	— 510	16	28,234	— 1,498	3·5	..
G.N., P'dy. & Brmtn	,, 18	10,875	+1,395	16	86,266	+25,856	9·25	·25
†L'pool Overh'd Rly.	,, 12	1,362	— 5	15	20,692	— 169	6·8	4·3
†Mersey Railway	,, 11	2,084	+ 105	15	28,738	+ 1,145	4·5	..
Metropolitan Rly.	,, 19	21,645	— 677	16	242,457	+ 1,819	24·5	..
Met. District Rly.	,, 18	16,804	+ 865	16	142,299	+15,847	24	..
Anglo-Argentine	,, 15	39,340	+3,098	16	277,451	+33,840	48	..
§Auckland	Mar. 27	11,212	+1,966	13	87,100	+ 4,948	19·2	·66
Bombay (B.E.T.)	,, 12	4,787	+ 723	10	24,263	+ 4,922	..	..
§Brisbane	,, 31	14.490	+1,291	..	..	..	..	..
Buenos A.& Belgr'o.	Apr. 15	8,094	+ 22	16	56,877	+ 745	..	..
†Calcutta	,, 4	3,292	+ 275	..	..	..	..	..
§Geneva	Feb.	6,940	+ 709	..	..	..	..	..
§Kalgoorlie, W.A.	March	4,264	..	12	11,319	..	20·5	..
Madras	Apr. 15	1,257	+ 135	16	9,015	+ 977	12·75	..
†Perth (W.A.)	,, 10	1,408	— 79	15	21,170	— 1,052	25·6	25·6

Compared with the corresponding period of 1907. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

MARKETS are in no whit benefited by their Easter recess, and business has not yet recovered even its normal state. Just before the holiday began, there was a slight flicker of activity, but it soon went out.

The Christmas weather which prevailed over three of the days is expected to have a beneficial effect upon the traffics of the underground and tube lines for Easter Monday. Prices, however, are irresponsive to any sort of hope. Metropolitan Consolidated was rushed up to 44¼ upon a bear scramble, relapsing to 43½. The electric stocks are no more than steady.

Electric lighting shares are quiet, and show practically no changes on the week. River Plate Preference improved upon a good report which shows the company to be getting into a strong position.

Newcastle-upon-Tyne Electric shares, amongst many others, are to be removed from the pages of the Stock Exchange Official List at the end of next week. They come under the operation of the Stock Exchange rule which removes official quotations after a certain length of time during which no business is marked. There is a small local market in Newcastle, but dealings even there are not what can be called free.

The Mexican electric issues have improved, and there is a little business doing in the best-known. Mexican Light and Power 5 per cent. gold bonds rose to 85, while the capital stock is better at 51. Mexican Electric Light Company 5 per cent. bonds hardened to 77.

Westminster Electric Supply shares, although their nominal quotation is unaltered, are really a little better at 7 11/16, and buyers have paid as much as 7⅞ within the last few days.

Further purchases of American telephone and telegraph capital stock lifted the price three more points, to 118½. This makes a rise of £8 in a fortnight. Less than six months back the shares were obtainable at 100.

National Telephone issues are firm, and there is a good deal being done in the Deferred stock between 108½ and 109½. Telegraph stocks are placid. Another fall in the Bank Rate is required to divert new attention to investment securities.

Babcock & Wilcox shares strengthened to 3¾ buyers upon the excellent report just out. The company's profit of £309,800 for the year shows an increase of £23,900 over the corresponding period, and the directors pursue the eminently sane policy of keeping the dividend at 20 per cent., while amply fortifying the reserves and the carry forward. Other manufacturing shares incline to dulness, the still threatening labour position in the North of England causing considerable uneasiness.

Tramway and Traction varieties have been irregular. Metropolitan Tramways Debenture stock eased off a point. Anglo-Argentine Tramways Debenture put on 2 and Lisbon shares have hardened, the Ordinary and Preference both rising to 22s. 6d. Mexico Tramways Common stock advanced appreciably to 82½, in sympathy with the rises in the country's light and power issues.

It is to be observed that the stocks in the Gas, Water and General Investment Trust have fallen heavily since reference was made here to some of the remarkable electric investments included in the company's recently issued schedule of holdings.

River Plate Electricity Co., Ltd.—The accounts for 1907 show a net revenue, after providing for debenture interest and all depreciations, of £17,290, as against £12,018 for 1906. After paying 6 per cent. on the preference shares, 6 per cent. on the ordinary shares is recommended, as against 2½ per cent. last year. £4 000 is placed to general reserve, as against £2,000 last year, and £5,410 is carried forward.

Monte Video Telephone Co., Ltd.—A dividend of 6 per cent. per annum (7½d. per share) is recommended on the ordinary shares for the half-year.

New Issue.—The *Times* states that the Rio de Janeiro Tramway, Light and Power Co., Ltd., has concluded arrangements in Paris and Brussels for placing £1,750,000 (one-half) of an issue of new 5 per cent. debentures.

Mexico Tramways Co.—The directors recommend a dividend at the rate of 4 per cent. per annum for the quarter ended March 31st, 1908.

Montreal Light, Heat and Power Co.—The directors have declared a dividend of 1½ per cent. on the paid-up capital stock, being at the rate of 6 per cent. per annum for the quarter ended April 30th last.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations April 18th.	Closing Quotations April 21st.	Business done week ended April 21st, 1908. Highest.	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	2 — 3	2 — 3	..	..	..	Nil
143,300	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	5 %	5 %	..	84 — 87	84 — 87	..	..	..	5 14 11
$131,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7¼%	7¾%	8 %	8 %	114 —118	117 —121	..	..	+3	6 12 8
53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	..	85 — 87	85 — 87	.85	..	..	4 12 0
622,600	Anglo-American Telegraph	Stock	2⅜%	3⅛%	3⅞%	3⅛%	55 — 58	55 — 58 xd	..	..	..	6 0 8
3,188,700	Do. do. do. 6 % Pref.	Stock	5⅛%	6 %	6 %	6 %	98½—100½	98½—100½	100	98½	..	5 19 5
3,188,700	Do. do. do. Deferred	Stock	Nil	⅛%	1⅛%	1 %	13⅝— 14½	13⅝— 14	13⅞	13⅜	— ½	7 3 10
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	5 %	5 %	5 %	98½—101½	98½—101½	..	..	..	4 18 6
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	8 %	8 %	..	7 — 7⅛	7 — 7⅛	..	..	..	5 6 8
2,800,459	Commercial Cable Sting. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	84 — 87	84 — 87	85⅝	85	..	4 12 0
16,000	Cuba Telegraph	10	5 %	5 %	5 %	..	7½ — 8⅛	7½ — 8⅛	..	..	..	6 5 0
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	16 — 17	16 — 17	..	..	..	5 17 8
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3⅛ — 3⅜	3⅛ — 3⅜	..	..	..	5 14 8
6,000	Do. do. 10 % Cum. Pref. ..	10	10 %	10 %	10 %	..	8½ — 9¼	8½ — 9¼	8¼	..	..	5 8 1
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	..	99⅜—102½	99⅜—102½	..	..	..	8 15 8
60,710£	Direct United States Cable	20	3⅜%	4½%	4½%	..	13½ — 14	13¾ — 14	..	..	..	6 12 2
53,700£	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	..	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	130 —135	130 —135	134	130	..	5 3 8
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	..	84 — 87	84 — 87	85¼	84½	..	4 0 6
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	..	101 —104	101 —104	102	..	..	3 16 11
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	12⅞— 13⅜	12⅞— 13⅜	13⅛	13⅛	..	5 4 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
286,800	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	98 —101	99 —101	..	..	+ ⅛	3 19 3
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 3,000	25	4 %	4 %	4 %	..	100 —102	100 —102	..	..	..	15 12 8
181,127	Globe Telegraph and Trust	10	5⅜%	5¼%	5¼%	..	9⅞ — 10⅜	9⅞ — 10⅜	10⅛	9⅞	..	5 6 0
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13⅜ — 14½	13⅜ — 14½	14	13⅜	+ ⅛	4 4 9
150,000	Great Northern Telegraph, of Copenhagen	10	24 %	24%	20 %	20 %	31½ — 33½	31½ — 33½	..	..	..	5 19 5
24,300£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	..	56 — 58	55 — 58	..	..	— ½	6 9
$41,380,400	Mackay Companies Common	$100	1 %	2 %	3½%	..	58 — 63	58 — 63	..	..	..	5 11 1
$20,000,000	Do. 4% Cum. Pref.	$100	4 %	4 %	4 %	..	62 — 66	62 — 66	..	..	..	6 1 8
384,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅞ — 1	⅞ — 1	8/9	..	+ 1/16	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	4 %	5 %	6 %	6 %	1⅛ — 1⅛	1⅛ — 1⅛	19/9	..	..	4 14 1
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	1 — 1	1 — 1	..	..	..	5 0 0
2,235,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107 —109	107 —109	108⅝	..	..	5 10 1
3,241,425	Do. do. Def. Stock	100	5 %	5 %	5 %	6 %	108 —110	108 —110	109½	109⅛	..	5 9 7
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	..	..	..	5 0 0
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	5 %	5 %	10 — 12	10 — 12	..	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	5⅝	..	..	4 8 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	98½	..	..	3 10 0
1,710,693	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101½—103¾	101½—103¾	102½	102	..	3 17 4
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6¾%	7 %	7 %	8 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	5 6 8
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	4 16 0
99,109	Do. do. do. 4 % Red. Deb. Stock ..	100	..	4 %	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	..	98 —101	98 —101	..	..	..	3 19 3
11,839£	Reuter's	8	5 %	5 %	5 %	..	7¼ — 8½	7¼ — 8½	..	..	..	4 19 3
99,100	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	4½%	4½%	..	99 —102	99 —102	..	..	..	4 8 3
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	128 —131	126 —129 xd	..	..	..	4 13 0
100,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6 — 6½	6 — 6½	..	..	..	6 3 1
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 15 3
15,609£	West African Telegraph, Shares	10	4½%	4 %	4 %	..	10 — 10½	10 — 10½	..	..	..	3 16 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	2½%	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	2 13 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	..	98 —101	98 —101	..	..	..	3 19 3
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	..	13½ — 13⅞	13½ — 13⅞	13⅞	13⅜	..	5 1 10
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	99 —102	99 —102	100⅛	..	..	3 18 5
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅛ — ¼	⅛ — ¼	..	..	..	Nil
84,568	Do. do. 6 % Cum. 1st Pref. ..	10	6 %	5 %	8 %	..	8½ — 8¾	8½ — 8¾	..	..	..	9 2 10
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	8½ — 9	8½ — 9	..	..	..	Nil
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

320,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	8 %	8 %	8 %	..	7⅛ — 8⅛ xd	8 — 8½	8⅝	8⅛	+ 1/16	4 17 0
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5⅛%	5⅛%	5⅛%	..	6⅛ — 6⅜	6⅛ — 6⅜	6⅜	6⅛	+ 1/16	4 6 3
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	..	129 —132	130 —135	..	..	+2	5 14 3
286,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	..	104 —107	104 —107	..	..	..	4 13 6
880,000	Babcock & Wilcox, 1 to 880,000	1	20 %	20 %	20 %	20 %	3⅜ — 3⅝	3⅜ — 3⅝	75/7½	73/-	..	5 0 8
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	5 16 10
40,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	3⅜ — 4⅛	3⅝ — 4¼	..	..	..	8 9 8
40,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	4⅜ — 4⅝	4⅜ — 4⅝	95/-	..	..	7 3 7
20,000	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 11 1
20,000	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..	4 14 1
238,200	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	101 —104	103	..	+1	4 16 2
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	5½%	5½%	97 —100	97 —100	..	..	..	5 10 0
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	8 %	132 —135	132 —135	..	..	..	4 8 11
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	110 —114	110 —114	..	..	..	4 7 9
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	106 —109	106 —110	..	..	+ ½	4 10 11
235,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	101 —104	99 —102	..	..	—2	4 8 3
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 2
133,301	British Electric Traction	10	6 %	3 %	Nil	..	1⅛ — 1⅜	1⅛ — 1⅜	32/6	26/3	+ ⅛	Nil
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	4 — 4½	4 — 4½	80/-	..	..	13 6 8
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	92 — 95	90 — 93	92½	..	—1	5 5 3
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	72— 76	72 — 76	74½	..	..	5 18 5
100,000	British Insulated and Helsby Cables	5	8 %	8 %	10 %	..	6⅜ — 6⅝	6⅜ — 6⅝	..	..	..	7 10 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	93 — 98	94 — 99	..	..	+1	4 10 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	..	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
1,016,358	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	..	45 — 50	45 — 50	..	..	..	8 0 0
50,000	‡ Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	1/16 — 1⅛	1/16 — 1⅛	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	2½%	Nil	..	0 — ⅛	0— ⅛	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	Nil	..	1/16 — ⅛	1/16 — ⅛	..	..	..	Nil
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	75 — 80	74 — 79	..	..	—1	5 13 11
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	60 — 65	59 — 64	..	..	—1	7 0 8
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	4 %	3 %	3 %	..	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	3 1 6
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 17 1
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 17 1
310,000	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	110 —116	110 —116	..	..	..	4 6 2
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
187,610	Calcutta Trams, 1 to 187,610	5	8 %	8 %	8 %	6 %	6 — 7	6 — 7	..	..	..	4 8 11
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,930..	5	..	5 %	5 %	6 %	5 — 5⅝	5 — 5⅝	..	..	..	4 13 0
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	102 —106	102 —106	..	..	..	4 4 11
35,000	Callender's Cable Construction shares	5	12½%	15 %	15 %	..	10¾ — 11¼	10⅝ — 11⅛	10½	10 1/16	..	5 9 1
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 5 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	..	105¾—109¼	106⅜—109½	..	..	+ ½	4 2 11
491,223	Cape E Trams., 1 to 491,223	1	5 %	Nil	Nil	..	1/16 — ⅛	1/16 — ⅛	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	6 %	8 %	..	1⅛ — 1 1/16	1⅛ — 1 1/16	27/6	..	..	5 11 4
315,045	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	100 —103	100 —103	102	..	..	4 7 5
1,893,610	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	3 %	75 — 78	75 — 78	76½	..	..	3 16 11
553,195	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	83 — 86	83 — 86	..	..	..	4 14 2
553,195	Do. do. Def. do.	Stock	4 %	4 %	4 %	2 %	54 — 57	54 — 57	..	..	..	3 10 2
1,480,000	City and South London Railway	Stock	2¾%	1⅞%	2¾%	2¾%	39 — 41	39 — 41	..	..	..	5 3 8

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations April 13th.	Closing Quotations April 21st.	Business done week ended April 21st, 1908.		Rise + or Fall —	Present Yield per cent.
		*	1904.	1905.	1906.	1907.			Highest	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	£	2½%	2½%	5 %	..	1¼ — 1⅝	1⅝ — 1⅞	..	..	— 1/16	7 16 10
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	..	92 — 95	92 — 95	..	..	..	5 5 8
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	7 5 5
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..	..	5 16 0
282,580	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	100—103	100 —103	..	..	..	4 7 5
60,000	Dublin United Trams. (1896), 1 to 60,000	10	6 %	6%	6 %	6½%	12½ — 13½	12½ — 13½	..	..	..	4 18 2
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½%	4½%	4½%	..	¾ — 1	¾ — 1	..	..	..	12 10 0
17,139	Do. "A" shares, 01—017,139	5	2½%	4½%	4½%	..	1½ — 2⅛	1½ — 2⅛	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	78 — 81	78 — 81	..	..	..	4 18 9
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	85 — 87	85 — 87	..	..	..	5 14 11
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	⅛ — ⅜	⅛ — ⅜	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	Nil	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	7⅞ — 8¼	7⅞ — 8¼	8	7⅞	..	6 1 3
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	87 — 90	87 — 90	..	..	..	4 8 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	4 %	¾%	⅜ — 1½	⅜ — 1½	20/-	..	..	6 6 8
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10½ — 10⅞	10½ — 10⅞	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	..	102 —103	102 —103	..	..	..	4 17 1
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15%	15 %	15%	10⅝ — 11⅛	10½ — 11½	11	..	..	8 18 10
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	4 3 9
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..	4 3 4
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	5 %	10%	10 %	..	15⅜ — 16⅛	15⅜ — 16½	..	..	..	6 1 3
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	Nil	Nil	⅓%	1⅜ — 1½	1⅜ — 1½	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	5 — 5⅜	5⅛ — 6	..	..	..	8 6 8
600,070	London United Trams. (1901), 1 to 50,007	10	6 %	8 %	8 %	..	6⅜ — 6⅝	6⅜ — 6⅝	..	..	..	4 8 11
399,930	Do. do. 60,008 to 100,000	10	6 %	8 %	8 %	..	6⅜ — 6⅝	6⅜ — 6⅝	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	..	6 — 7	6⅛ — 7⅛	..	..	+ ⅛	6 13 4
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	..	80 — 85	80 — 85	82	..	..	4 14 2
5,732,062	Metropolitan Consolidated	100	3 %	2⅝%	1 %	⅓%	43 — 44	43 — 44	44⅛	42⅝	..	1 2 9
2,640,914	Do. Surplus Lands	..	2⅝%	2⅝%	2⅝%	2⅝%	66 — 68	66 — 68	..	..	..	4 0 11
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	11¼ — 12¼	12 — 13	12⅜	11⅛	+ ⅛	Nil
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	..	1/16 — 1/8	1/8 — 3/16	1/6	1/-	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	¼ — ⅜	¼ — ⅜	15/9	15/-	..	5 14 3
350,000	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	95 — 98	94 — 97	94	..	—1	4 12 9
245,500	Potteries E. Trc.	1	5 %	4 %	4 %	..	⅛ — ¼	⅛ — ¼	..	..	..	8 0 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅜ — ½	⅜ — ½	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 18 9
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	17½%	31 — 33	30½ — 32½	32	30½	— ½	6 9 8
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	5 %	5 %	5 %	5 %	39 — 43	39 — 43	40½	..	..	6 13 4
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	Nil	Nil	10 %	1 — 1⅛	1 — 1⅛	20/-	..	..	6 13 4
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	Nil	Nil	..	6 %	5⅜ — 5¾	5⅜ — 5¾	75/-	..	..	7 10 0
46,404	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 77	72 — 77	73	72½	..	5 1 0

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P,. 1 to 15,000	5	5½%	5½%	5½%	..	4½ — 5 xd	4⅝ — 5	..	..	..	5 10 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
30,131	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10%	10 %	7⅞ — 8¼	7⅞ — 8¼	..	..	..	6 1 3
9,869	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	4 10 4
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
80,000	Charing Cross and Strand Electricity Supply	5	8 %	5 %	5 %	5 %	3⅝ — 4⅛	3⅝ — 4⅛	..	..	..	6 1 3
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..	5 0 0
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
49,486	Chelsea Electricity Supply, Ord.	5	6 %	6 %	4½%	..	3⅝ — 3⅞	3⅝ — 3⅞	71/3	..	..	6 4 2
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	..	101 —104	101 —104	..	..	..	4 6 7
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	9⅞ — 10⅛	9⅞ — 10⅛	9⅞	..	—⅛	5 14 3
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11½ — 12⅝	11½ — 12⅝	12⅝	..	..	4 16 0
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..	3 19 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	104	103	..	4 6 7
40,000	County of Durham Electrical Power, Ord.	5	£3 7 0	4 %	4 %	..	3 — 3⅜	3 — 3⅜	..	..	..	5 6 8
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	..	4¼ — 4⅜	4¼ — 4⅜	..	..	..	5 5 3
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4½%	5 %	5 %	5 %	7⅞ — 8¼	7⅞ — 8¼	..	..	..	6 1 6
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅝ — 11¼	10⅝ — 11¼	11	10⅞	..	5 6 8
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..	4 1 10
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	4 %	Nil	..	⅜ — ⅝	⅜ — ⅝	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	3 %	..	¾ — 1⅛	¾ — 1⅛	..	..	..	12 0 1
433,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	..	58 — 63	57 — 62	..	..	—1	7 5 2
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4½ — 5	4½ — 5	..	..	..	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	5 %	5 %	5 %	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
15,000	Hove, 1 to 15,000	5	8½%	9 %	9 %	8½%	6½ — 6⅝	6½ — 6⅝	..	..	..	6 13 4
21,000	Kensington and Knightsbridge Electric Ord.	5	12 %	10 %	10 %	..	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
10,000	London Electric Supply Corporation, Limited, Ord.	3	3 %	4 %	4 %	2½%	1 — 1⅛	1 — 1⅛	..	..	..	5 0 0
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4½ — 5	4⅝ — 5	..	..	..	6 0 0
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4½%	4½%	90 — 93	90 — 93	91⅞	90⅜	..	4 16 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	10 %	8 %	6½%	4⅜ — 5⅛	4⅜ — 5⅛	100/7½	97/6	..	6 3 11
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5⅛	4⅜ — 5⅛	5	..	..	8 18 3
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	107 —111	107 —111	..	..	..	4 1 1
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	85 — 90	85 — 90	..	..	..	3 17 9
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	..	96 — 99	96 — 99	..	..	..	4 5 10
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	..	5⅞ — 6⅛	5⅞ — 6⅛	..	..	..	6 10 7
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	7 %	7½%	7½%	7½%	11½ — 12½	11½ — 12½	..	..	..	5 12 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	5⅝ — 6⅜	5⅝ — 6⅜	..	..	..	5 9 10
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	5 17 8
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	12½%	10 %	10 %	7½ — 8¼	7½ — 8¼	7⅞	7⅝	..	6 3 1
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6½ — 7	6½ — 7	..	..	..	5 0 0
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3 %	3½%	3½%	85 — 90	85 — 90	..	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	Nil	Nil	¾ — 1½	¾ — 1½	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	70 — 74	70 — 74	..	..	..	5 8 1
65,000	South London Electricity Supply, Ord.	5	4 %	4 %	3 %	4 %	2⅜ — 2⅝ xd	2⅜ — 2⅝	..	..	..	6 19 2
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	2½%	2½%	2½%	⅜ — ⅝	⅜ — ⅝	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 1 10
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	11 15 4
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	1¼ — 2⅜	1⅛ — 2⅛	..	..	— ⅛	11 1 10
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	..	87 — 90	87 — 90	..	..	..	5 0 0
110,000	Westminster Electric Supply, Ord.	5	14 %	13 %	12 %	10 %	7⅛ — 8	7⅛ — 8	..	..	..	6 5 0
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	4½%	4½%	4½ — 5⅛	4½ — 5⅛	..	..	..	4 5 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. ‡ Interim Dividend.

Bank rate of Discount 3 per cent., March 19th, 1908.

SOME NOTES ON HIGH-TENSION INSULATORS FOR OVERHEAD TRANSMISSION LINES.

By C. J. GREENE.

(*Continued from page* 676.)

Insulator No. 1.—Test No. 1.—On running up the voltage, sparking began at 73,000 volts, but it was not until 84,000 volts was reached that the air between line and pin was broken down completely and a permanent arc established. This point is represented by circle No. 1 on the curve of arcing distances, p. 675. Immediately after the permanent arc was established, the insulator was punctured between line and pin, the puncture occurring at a point near the top of the insulator, and not in the neighbourhood of the transmission wire.

Insulator No. 2.—Two insulators of this type were tested, tests Nos. 2, 3 and 4 being carried out on one of them, and tests Nos. 5 and 6 being carried out on the other.

Test No. 2.—With the insulator in a clean and dry condition, sparking began at 80,000 volts, and a complete breakdown of the air took place at 90,000 volts, a permanent and vicious arc establishing itself between line and pin.

Test No. 3.—There being no means of carrying out a spray test, the insulator was wetted all over with clean fresh water and the pressure again applied. The first spark jumped across at 45,000 volts, and an arc almost established itself, but the heat thus generated caused the insulator to dry, and the arcing ceased. The pressure was then gradually increased, and with each slight increment of pressure an arc attempted to establish itself, but was extinguished by the further drying of the insulator. This phenomenon was repeated at every slight increase of pressure till at 90,000 volts, the insulator being then probably quite dry, a permanent arc was established.

Test No. 4.—The same insulator was then taken, and the whole of its surface with the exception of that of the inside of the inner shed was coated with a mixture of coal dust and water, so as to represent the condition of insulators working in the neighbourhood of collieries and railways. The first spark started again at about 50,000 volts, at which pressure the insulator began gradually to dry and clean itself, the discharge from the insulator throwing off the dirt. This process of drying and cleaning proceeded as the pressure was gradually increased up to 85,000 volts, at which pressure a permanent arc was set up. This process of the insulator cleaning itself is one of great interest and importance, but it is probable that it only takes place with sufficient rapidity to be of service at pressures much greater than are at present in use in this country. At low pressures it appears that the force of repulsion between the surface of the insulator and the similarly charged particles of dirt is not sufficient to cause these particles to be repelled. The reason why the permanent arc established itself at 85,000 volts instead of 90,000, is probably due to the fact that the insulator was not quite clean, and that the remaining particles of dirt acted as needle-points. Circle No. 2 on the curve of arcing distances represents the arcing voltage of the insulator dry, and circles Nos. 3 and 4 the voltage of the insulator wet and dirty.

Test No. 5.—Another insulator of exactly the same type was then taken and tested in a clean and dry condition. At 92,000 volts a permanent arc was set up between the transmission wire and the pin. Almost immediately afterwards the insulator appeared to puncture through the inner piece to the pin, the outer piece remaining sound.

Test No. 6.—To test whether this was so the pressure was again applied to the insulator, and on its reaching 70,000 volts the outer piece was also punctured, there now being a complete breakdown of the material in both inner and outer pieces. Circle No. 5 on the curve represents the arcing voltage of test No. 5. There is, of course, no circle for test No. 6.

Insulator No. 3.—This insulator, it may be remarked, is the standard insulator used on the Lancashire Electric Power Co.'s overhead 11,000-volt mains, so that the R.M.S. pressure between line and pin is, under normal conditions, about 6,500 volts, and it would appear from the tests that the insulator is capable of use with very much higher pressures.

Test No. 7.—The insulator was tested in a perfectly clean and dry condition. The first spark jumped over between line and pin at 94,000 volts, and a permanent arc established itself at 97,000 volts, whilst at 99,000 volts the insulator punctured right through from the line to the pin.

Test No. 8.—Another insulator of exactly the same type was tested under the same conditions. The first spark jumped over at 81,000 volts and a permanent arc was set up at 99,000 volts. We were unable to puncture the insulator at this pressure.

Test No. 9.—Another insulator of exactly the same type was tested under the same conditions. The first spark jumped over at 82,000 volts, and a permanent arc established itself at 101,000 volts. The insulator was not punctured at this voltage. Circles Nos. 7, 8 and 9 represent the results, as plotted on the curve of arcing distances.

The exact positions of the punctures which took place are marked on the drawings of the insulators.

Direct Deductions from Tests.—It is, of course, impossible from the small number of insulators tested to attempt to formulate any hard and fast deductions; one would not be justified in doing so. It can only be stated that such tests as were carried out indicated certain results which it appears probable would be confirmed by carrying out a number of further tests under the same conditions, and the writer can only add that he has seen the results of quite independent tests carried out on the same type of insulator in another part of the country, which results agree almost in detail with those mentioned above. The writer, however, is not at liberty to publish these results.

Puncturing Voltage.—It appears, first, that an insulator does not by any means necessarily puncture in its thinnest place, nor does the puncture necessarily form the shortest path of breakdown between line and pin, the insulator puncturing at some point of local weakness which the electric pressure finds out. It is probably quite a mistake to make any single part of an insulator with a greater thickness than 1 inch. Masses of porcelain vitrified under great heat suffer from the same defects as large masses of iron which cool unequally. By unequal cooling, local internal stresses are set up in the mass of porcelain which manifest themselves at the first opportunity, since these stresses by trying to adjust themselves can only do so by fracture of the porcelain. This fracture may be caused by a blow, rough handling, exposure to heat or the rays of the sun, or by electric pressure. It is for this reason that insulators of any size should unquestionably be made in two or more pieces and then cemented together.

The fact that the position of breakdown cannot be foretold also points to the absolute necessity of *pressure testing every insulator* before erection, and to the desirability of immersing the head of the insulator in water and filling the pin-hole when applying the test. By carrying out the test in this manner the weak points are subjected to a searching test. It is interesting to note that the average puncturing voltage of the porcelain tested is approximately 100,000 volts per inch.

Arcing Distance.

From the table and curve mentioned above it is evident, and of course only to be expected, that all insulators of the same type and size will flash over at the same voltage when the conditions of test or working are similar, and it will be seen that this voltage—for the insulators tested—is in the neighbourhood of 10,000 volts per inch of air space. This ratio agrees almost exactly with the ratio obtained by the tests on the arcing distance between the rods. At the lower pressures the ratios agree exactly, but at the higher pressures it takes a greater pressure per inch of air space to cause a breakdown between line and pin than between rod and rod.

It will also be noted that in the cases of insulators Nos. 1 and 3, both of which have three sheds, the volts per inch of air-space are considerably greater than in the case of insulator No. 2, which only has two sheds. The action of this third shed would therefore appear to be beneficial, the ratio being improved either on account of the greater creeping surface between line and pin or on account of some cooling action

of the middle shed on the arc. The experiments carried out up to date are unfortunately insufficient to throw much light on this and cause any definite theory to be formed.

The arcing distance of an insulator falls naturally under two heads: The arcing distance when dry, and the arcing distance under conditions of wind and rain. The former condition is only met with in a few special cases, such as where insulators are used to support short lengths of bare

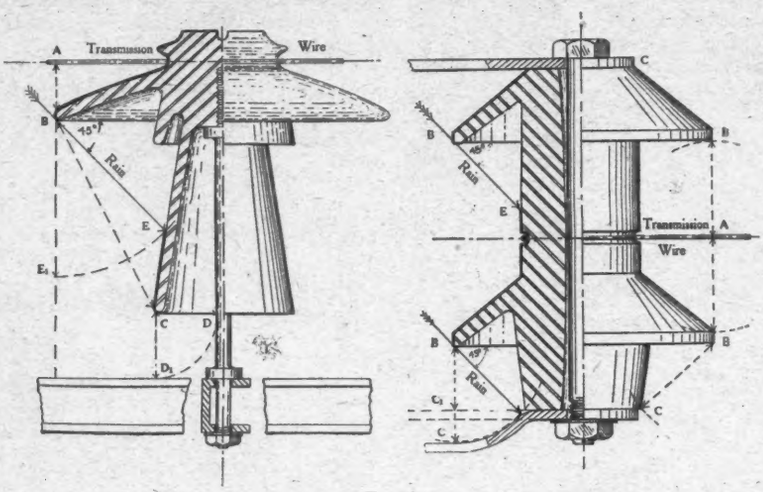


Fig. 3.

conductors, choking coils, &c., in generating stations, and it is with the latter condition that we are chiefly interested.

Arcing Distance Dry.—This depends on—

(*a*) The actual minimum distance between wire and pin.

(*b*) The cleanliness of the insulator.

(*c*) The temperature.

(*d*) The barometric pressure.

(*e*) The state of the atmosphere.

(*a*) To illustrate this distance, two drawings of insulators are given (fig. 3), one being the ordinary mushroom or straight-line insulator, and the other the shackle insulator for use at sharp angles or for terminating a line. The drawings in this case are not to scale, as this is not necessary, but they are sufficiently large to illustrate the following remarks. Taking first the case of the straight-line insulator, it will be noticed that the transmission wire is shown as fastened to the side groove and not to the top groove. The reason of this is that whenever we come to a slight curve on a line it is necessary to bind the conductor to this side groove, the conductor only being placed in the top groove on practically straight runs. As it is not desirable to have more than one type of insulator on one line, the efficiency of the insulator must be determined from the most disadvantageous position of the transmission wire, *i.e.*, the side groove, as it is obvious that in that position the arcing distance is very materially decreased. It might perhaps be possible to economise on any given line by using a somewhat smaller insulator on the straight runs, but this is a refinement not attempted at present, and with the pressures at present reached in this country the saving in cost would be so small as to be outweighed by other disadvantages. In the case of the straight-line insulator therefore, the arcing distance is evidently A B + B C + C D, and it may be noted at once that the distance C D from the bottom of the lower petticoat to the pin must directly govern the distance C D_1 from the lower petticoat to the cross arm. If C D_1 were less than C D the arcing distance would be correspondingly reduced. In practice it is usual to make C D_1 equal to the radius of the bottom petticoat. C D_1 is therefore somewhat greater than C D, as the diameter of the pin is left out of account, and this arrangement allows a slight factor of safety against the accumulation of snow and water, and the splashing of rain drops, on the upper surface of the cross arm.

Coming to the case of the shackle insulator, there is only one position for the transmission wire, and it will be seen from the drawing that the arcing distance when dry is A B + B C. A point well worth noticing and one which can easily be overlooked is the shape of the straps forming the shackle ironwork. If the bottom strap is made perfectly straight, as is shown by the dotted line in the drawing, the arcing distance can quite easily be decreased, and the efficiency of the insulator correspondingly reduced, the distance B C_1 becoming less than B C. The lower strap should, therefore, be bent as shown to a curve having a radius equal to B C.

(*b*) The question of the cleanliness of the insulator affecting the arcing distance has already been referred to in connection with the tests, and there is no doubt that a really dirty insulator, even when dry, will arc over at a considerably lower voltage than a clean one. With insulators working under cover, however, it would appear that in the case of high pressures they would tend to clean themselves as in the case referred to in the tests; the particles of dust and dirt, becoming electrified, would be repelled from the insulator by the static force of repulsion.

(*c*) Rise of temperature decreases the voltage at which any insulator will arc. Sparks are longer and straighter through hot air than cold air, the dielectric strength of air varying in inverse proportion to its absolute temperature.

(*d*) At atmospheric pressure the length of spark varies approximately in inverse proportion to the pressure.

(*e*) In steam or in wet fogs, American authorities state that a given pressure will jump a much greater distance than in dry air, it being asserted that in the case of steam the distance is doubled, and in the case of fog the distance is increased 25 per cent.

It is evident that conditions (*c*) and (*e*) are of importance in the case of insulators fixed in hot engine rooms, and when much moisture is in the air from leaky steam pipes, stuffing boxes or other causes.

(*To be continued.*)

PUBLICITY FOR SMALL UNDERTAKINGS.

By B. N.

(*Concluded from page* 681.)

Electric Irons and Radiators.

Irons are now extensively used, and are very reliable and satisfactory, and a small undertaking can usually place a considerable number on circuit.

Where an iron is used only occasionally in a private house, current may, perhaps, be taken from the lighting supply, but if the whole ironing of the house is to be done electrically, the irons must be supplied with current at a reduced price, otherwise the cost is going to be too heavy. It will generally be found that about half the lighting rate can be obtained for this supply.

At 2½d. per unit, each iron in domestic use may bring in from 20s. to 30s. per annum, and it is worth while to send out circulars advertising their use.

In many places irons are let out on hire, but as they only cost about 20s. each, it does not seem at all necessary to hire them out.

Where there is no radiator circuit with its special meter from which irons can be taken, the recently introduced submeters, costing about 10s. each, can be used with advantage to ascertain how many units have been used at the reduced price.

When sending out the circulars advertising irons, it is well to enclose a reply card and to offer the free use of an electric iron for a fortnight on trial. The risk of stocking a

ew irons is not great, and, if necessary, the makers will usually send down a few on sale or return.

Many wild suggestions have been made that irons should be sold below cost price, or even given away in order to encourage their use, but as it is to be presumed that most of the readers of the Electrical Review are sane people, it is not necessary to waste time by considering so ridiculous a suggestion.

When applying irons to laundry and trade purposes, considerable care is necessary to make the installation a success, as the heating elements must be proportioned to the work, that is, for wet material a greater heating power is required than for dry material, because the heat is more rapidly carried away.

It has been found that with electricity at 1½d. and gas at 2s. 6d., electric irons are cheaper than gas irons, and every manager should try to connect up such businesses as laundries, dry cleaning, &c. It will be found to pay in these cases to give each individual worker a few hints on the use of the irons, as the success of the installation often depends on the verdict of the operator.

The use of radiators is now so well known that nothing need be said on the subject except that it is generally bad policy to let them out on hire, and it is far safer to send them out on a week's free trial.

The use of cheap sub-meters instead of a separate circuit should be considered by all managers, and they are particularly useful where radiators are sent out on trial. These meters would be even more useful but for the fact that lighting circuits are generally wired with so small a size of wire that it is not safe to use a radiator and sub-meter because of overheating the wire.

Many managers are beginning to doubt the value of a radiator load supplied at a low price, because it is found that a very large number of radiators are used for occasional purposes only, and very frequently they are used at the time of the station peak load.

Even with current at 1d. per unit, radiators are too costly for general heating purposes, and as they seem to be principally useful for places where heat is only occasionally required, it would appear to be better policy to charge a reasonable price for current for heating, and be content with a little business at good prices, rather than a large business at a price that may not be remunerative.

Sundry Small Apparatus.

Under this heading are included fans, kettles and other things of a like nature. These should all be pushed, but it is necessary to use considerable discretion as to the money spent on bringing them to the notice of the public. It must always be remembered that they sell very little current, and consequently it is not worth spending much money to push them.

The principal value of these small articles lies in the fact that they tend to make electricity supply popular, and for this reason alone no supply station can afford to neglect them.

Nothing is here said about large cooking apparatus, because electrical cooking to the exclusion of all other means is not commercially possible at the present time in small towns. Many of us believe it will be possible in the future, but it is no use pretending that it is worth while pushing it at present.

Conclusion.

For some time past it has been the fashion to abuse the managers of electric supply undertakings, and to blame them for most of the troubles of the electrical trade. It is said they are too conservative, they will not take up publicity. In some few cases this may be justified, but the majority of the men in charge of undertakings are quite alive to the necessity of obtaining new business. They only differ from their critics in that they realise that in very many cases publicity cannot possibly bring in sufficient business to pay the costs of the publicity department.

The mere fact that many men have been found sufficiently foolhardy to go in for free-wiring and hire of arc lamps should remove any reproach of conservatism, though it rather bears out the criticism that many managers lack commercial ability.

It is frequently asserted that lavish publicity and low rates for hire of apparatus pay in America even in small towns, but the following extract from a paper published in the *Illuminating Engineer* (America), appears to show that everything is not plain sailing, even in America :—

"It would seem that disadvantages accrue to the company . . . . among which may be mentioned : an enormous investment in appliances which rapidly deteriorate in value, principally because of improvements constantly being made in the construction of such appliances.

"The superintendent of a very large gas company recently remarked that his company did not attempt to keep up with the times in this particular—was, in fact, still buying an earlier design of lamp, and dared not show or light up his office with the latest pattern, because as soon as his old consumers saw them there would be a clamour for a change, and his company could neither afford to comply with such requests nor to offend the good old consumer by refusing."

It is true that this was written of a gas company, but it applies with equal force to electricity supply.

It must always be remembered that in America nearly every town and industry is increasing in size, but in this country many of our provincial towns are decreasing in population, and many of our industries are dying out.

The real reasons for the slow advance in electrical enterprise lie much deeper than the critics of the central station man appear to imagine, and if some of these critics would read Mr. Garcke's "The Progress of Electrical Enterprise," they might be less inclined to throw stones at a class of men the vast majority of whom are trying to do their work under far from easy circumstances.

As a general rule, central station men are just as anxious as any other class that everything should be done to increase the use of electrical energy. The main difference between them and their critics is that they hold it equally criminal to rush recklessly into extravagant publicity schemes as to neglect publicity entirely.

There seems to be no doubt that a moderate amount of money spent on publicity can produce good results, but what many people appear to forget is that it is better to do no business at all than to trade at a loss.

PRINGLE'S EMERGENCY BRAKE.

"There will be a single service brake and a single emergency brake. . . . And the emergency device will be a brake which cannot be utilised conveniently as an alternative to the service brake, is constructed with a minimum of parts, each amply strong enough to withstand the most violent usage imaginable, and one which is brought into instant and full action from either end of the car by a single elementary motion which calls for no exercise of discrimination or judgment."

Thus our leader of April 19th, 1907. Mr. Pringle's brake fulfils these desiderata to the letter.

Figs. 1, 2 and 3 show the first practical designs, and reference to the other illustrations will demonstrate how little the principle of the brake has been altered in the latest form. Briefly, the brake consists of a skid, which drops into the *groove* of the rail by gravitation of the heavy mass of the moving parts, and allows the flanges of the trailing wheels of the car to run up on to it. About half the total weight of the car is then borne on the skids, which slide along the groove until the intense friction brings the car to a standstill.

We believe that previous attempts or suggestions have been made to use skids for emergency braking purposes, but this is the first time that the groove has been utilised, and it will be obvious that the groove has great advantages over the tread of a rail as a frictional surface, especially where the latter is greasy, as it has been almost always when serious run-away accidents have occurred. The groove of a tramway rail on a hill is either quite clean, as after a heavy fall of rain, or more or less choked with grit. Both of these conditions are good for braking so long as the skid is able to cut its way into fairly good contact with the *sides* of the

groove. The bottom of the groove is not required by this brake.

In the first patterns (figs. 1, 2 and 3) the skid was hinged on the axle, and it is possible that a heavy thrust was taken by the axle during the application of the brake. A great number of tests were made with this pattern, always on the same car, and the axle did not appear to suffer in the least; but Mr. Pringle succeeded in removing any risk that there may have been of an axle breaking at a critical moment, and at the same time did away with a bearing which would require maintenance and oiling, by attaching the whole gear to the side frame. In this design no stresses are thrown on the side-frame through the link suspension, and there seems to be but small chance of any part of the gear

4. It calls for no violent exertion on the part of the operator, and this, taken with the previous advantage, reduces to the smallest the risky personal element.

5. It is in duplicate. Both skids are released at the same moment, but in the event of one failing the other provides an ample safeguard.

6. It takes no heed of locked wheels, and this advantage is of such enormous value that it should have headed the list. The skids get under the wheel flanges, whether the wheels are revolving or skidding. When we consider what a sombrely important part locked wheels have played in all our car tragedies, we cannot be too thankful that means have been devised at last to bring the villains' machinations to nought.

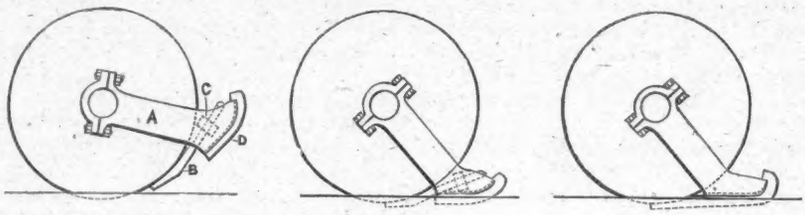


FIG. 1. FIG. 2. FIG. 3.

A, radial arm; B, skid; C, adjusting nut; D, shoe.

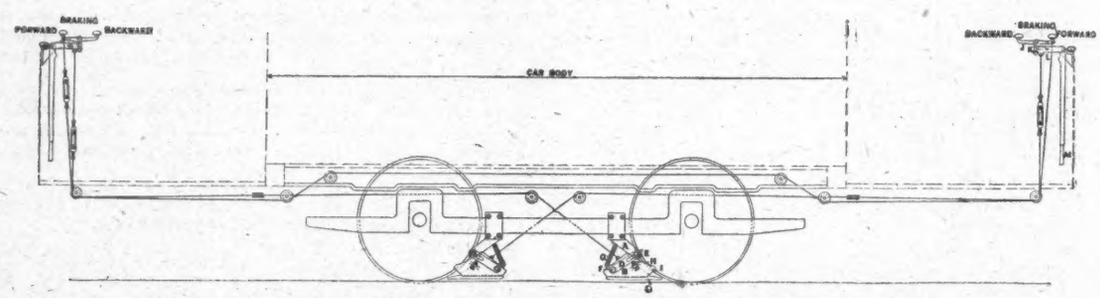


FIG. 4.—ARRANGEMENT OF PRINGLE PATENT GROOVE SKID BRAKE.

A, bracket B, brake-block; C, skid; D, link E, F, bolts; G, spring; H, adjusting screw; I, guide; J, operating lever; K, detent; L, trip-lever; M, restoring lever.

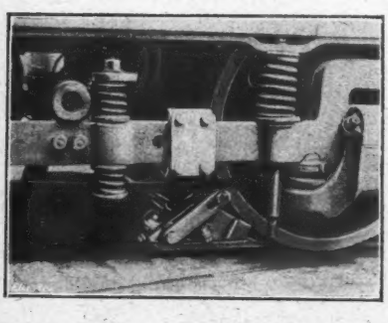


FIG. 5.—BRAKE LIFTED OUT OF ACTION.

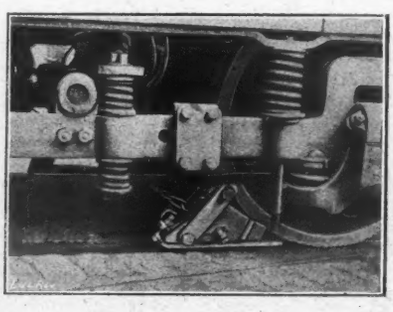


FIG. 6.—POSITION OF SKID WEEN FIRST DROPPED.

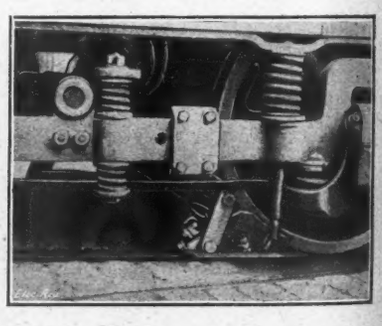


FIG. 7.—BRAKE IN ACTION; WHEEL LIFTED FROM TRACK.

"carrying away." If such a thing did happen to the skid on one side, the skid under the other wheel would pull up the car with certainty, but at a greater distance from the point of application. (See table of tests.) Mr. Pringle states that the failure of one skid only reduces the available braking power by about 40 per cent.

We will now state shortly the advantages claimed for this brake:—

1. Its application is instantaneous, and at full power.

2. It can be applied from both platforms, when running in either direction, and by no possibility can an attempt to apply it simultaneously from both platforms hinder and nullify its normal action. Moreover, when once applied, no human power can take it out of operation until the car is stopped, and run back to clear the skids.

3. Its application calls for the most elementary action, consisting as it does of striking a knob placed adjacent to the controller. This action releases a detent, and upon that the whole gear hangs.

7. It is independent of the greasy condition of the rail tread, and does not rely for its efficiency upon the application of sand.

8. We think little of the fact that the hand-brake can be used on the front wheels, even when the skids are dropped as they lock the trailing wheels only; and, for the same reason, a rheostatic brake or a magnetic slipper-brake can be used with some effect, so long as the front wheels are rotating.

The point of much greater importance to our mind, is that the application, or non-application or misapplication, of any other brake whatsoever can in no way limit the fall and free action of the emergency brake.

9. The brake is equally available for instantaneous application as a scotch to prevent the car running back.

10. As its operation depends upon the weight of the car, it is all the more effective when the car is heavily loaded.

11. Its action does not produce such rapid deceleration as to throw the passengers about, or even to shake them

Date of test.	Falling grade.	State of rail.	Speed, M.P.H.	Stop in feet.	Stop in seconds.	Stop in ft. per sec. per sec.	Remarks.
Dec. 28th, 1907	1 in 12	Dry and clean	6½	9½	—	—	Curve 370 ft. radius. Hard frost. Burton section groove. Skids already used for a number of tests. No sand used.
,,	,,	,,	10½	35½	3½	4·53	
,,	,,	,,	14	64	5½	3·80	
,,	,,	,,	15½	86	6⅞	3·53	
Dec. 29th, 1907	1 in 12	Greasy	7	14¼	2½	4·27	Same situation. Thaw. Same skids, without alteration. No sand. Compare these tests with those made Dec. 28th, for action on greasy and dry rails respectively, and note for both that hundreds of tests had been made already on the same length of rail, so that the grooves were not in a normally rough, rusty condition, but polished and smooth.
,,	,,	,,	9⅜	20½	2½	5·08	
,,	,,	,,	12	43	4¼	4·16	
,,	,,	,,	16	84	6	3·88	
Jan. 20th, 1908	1 in 12	Greasy	6½	9½	1	9·5	Straight track. Frost at night but slight thaw during tests, making track conditions very severe. No. 1 British Standard rail. Skids used a number of times previously on Burton rail section. See sketch C, fig. 8, for shape of skids at end of the present tests. No sand used. Note better results owing to rail not being used previously for these tests.
,,	,,	,,	10½	26½	2½	6·95	
,,	,,	,,	13½	53½	4	4·82	
,,	,,	,,	13¾	48	—	—	
,,	,,	,,	16½	83	5⅜	4·3	
,,	,,	,,	18½	106	6½	4·36	
,,	,,	,,	21½	115	6⅜	4·77	
Jan. 21st, 1908	1 in 12	Greasy	15	99	6½	3·21	Same *locus* as tests made December 28th and 29th, 1907. Skids in same condition as at end of test made January 20th, 1908. Sketch shows that bearing surface of skid was comparatively small and more flat-bottomed.
,,	,,	,,	15½	67	6⅜	3·53	
Jan. 24th, 1908	1 in 12	Greasy	15	55	3½	5·76	Same *locus*. Dense fog with greasy track. Skids re-formed as sketch A, fig. 8, with edges almost square and sharp, to show how little necessary is a large bearing surface. This test should be compared with the one immediately preceding.
,,			15	54	4	5·47	
April 6th, 1908	1 in 12	Good	13	38½	—	—	Tests taken over same rails as on January 20th, 1908. All tests made on down rail over same stretch of track, this being quite straight. As the tests proceeded the groove became burnished, so rendering the later tests not quite so effective as the early ones.
(*a*)	,,	,,	18	62	5	5.27	(*a*) Patches of concrete in one groove over the last one-third of the distance. At these places the skid made defective metallic contact with the groove, thereby making the stopping distance rather longer than it should have been.
			24	157	6⅜	5·46	
(*b*)	,,	,,	16	66½	—	—	(*b*) Before dropping the skids the wheels were locked by applying rheostatic brake fully and then the hand brake. At 15 M.P.H. the wheels were locked, but the car was still accelerating when the skids were dropped so that the speed was probably 16 M.P.H.
(*c*)	,,	,,	13	75	—	—	(*c*) The right-hand skid was held out of action to demonstrate the effect of one skid alone. The right-hand rail was sprinkled with water to make it greasy, and so prevent flats.
(*d*)	,,	,,	21	128	—	—	(*d*) *Brake applied while controller on last power notch, and power not cut off until car stopped.* The circuit-breaker did not blow as the wheels continued to revolve slowly on the skids. The brake was applied from the rear platform. There was concrete in the groove for the last quarter of the distance, and this would affect the test as before.
			4½	2	—	—	
			7	12½			
			10½	24			
(*e*)	,,	,,	—	—	—	—	(*e*) Scotching action tested by car being driven up hill, circuit-breaker being opened, and brake then applied by the motorman. The car came to rest perfectly smoothly without running back an inch.
(*f*)	,,	,,	—	—	—	—	(*f*) With the car, as above, the motors were reversed and power applied up to last series notch. The car did not move, and finally the circuit-breaker opened automatically.

violently; neither is any apparent damage done to the car, the brake, or the rails.

12. It can be applied with equal safety on a curve as on the straight.

The above table of tests clearly shows the powerful action of the brake, and we draw especial attention to the test

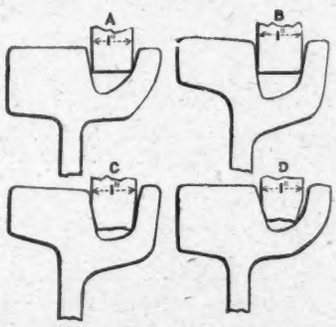


Fig. 8.—Groove Skid Brake.

A, new skid in Burton rail, as used in Jan. 24th tests, groove 1¼" wide × 1" deep
B, new skid in No. 1 British Standard rail; C, shape of skids at end of Jan. 20th tests; D, shape of skids at commencement of Jan. 21st tests in Burton section rail.

at 4½ M.P.H. in which the car travelled only 2 ft. This shows how very instantaneously the skids come into action.

In all tests the retardation is *exclusive* of the effect of gravity on a 1 in 12 falling grade, which would raise the figures by about 2·68 ft. per sec. per sec.

The following description of the car applies to the whole of the above tests:—Brill, 4-wheel trucks; open top deck; two 25-H.P. motors; weight of car complete, 8 tons; from four to seven persons on car during tests. All these tests were made in the presence of some entirely independent person, generally the editor or representative of a technical journal, and we ourselves can vouch for the accuracy of several sets.

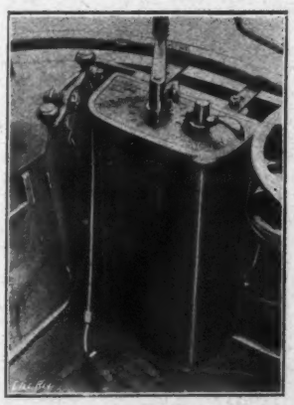


Fig. 9.—Brake Operating Gear to Left of Controller, The long handle is for lifting the skids after dropping.

We forget for the moment whether the Board of Trade have yet deleted from their regulations governing the operation of tramways, the clause relating to a maximum speed governor, which should put on the full brake power automatically when a certain speed was exceeded. This clause was enforced on many steam tramways, as the machinery lent itself to the application of such a device, but it became a dead letter upon the introduction of electric traction and has remained in abeyance ever since. We should not look with any favour upon its re-enforcement, as we think that it would hamper needlessly the legitimate increase of maximum speeds which, under ordinary conditions, are quite safe, but we cannot refrain from the remark that an automatic device of the necessary simplicity could be applied with great ease to Mr. Pringle's new emergency brake. We fear that Mr. Pringle himself, as a tramway manager, will not thank us for the suggestion!

We understand that the two Brake Committees are taking great interest in the brake, and Mr. Fell has been carrying out tests with it on his double-truck cars.

ELECTRICALLY-DRIVEN STREET-SPRINKLER.

The machine illustrated herewith (used in Germany) replaces a watering-cart, mechanical brush, and street-sweeping men, for it washes, cleans, and dries the street. This constitutes a great advantage, as the pavement is made safe for driving, while the ordinary sprinkling wagon leaves it in a very wet state which soils and endangers all vehicles, especially those going fast. Another considerable advantage is the mechanical method of propulsion. Electric motors are used, and the

Electrical Street Sprinkler.

vehicle is about three metres shorter than a horsed machine. The batteries are carried on the front-chassis, suitably enclosed. Charging is done at 100 volts. There are 40 cells feeding two 4-h.p. motors which drive the front wheels. Five forward speeds are possible, and three reverse and brake positions. In addition a hand brake is provided. The wheels have no rubber tires, this being permissible on account of the electric propulsion.

The consumption of water is very low, as every drop is utilised, and also of power—the apparatus can work fully 15 hours without recharging. The time taken to return empty to the water-station can be cut down considerably, thus increasing the economy of the service.

Electrical Standardising, Testing and Training Institution.—As a result of the recent scholarship examination, the governors of Faraday House have awarded an exhibition of 20 guineas per annum, tenable for three years, to Cyril Launcelot Underwood, of the Grammar School, Bedford.

POINTS IN CONNECTION WITH MAINS LAYING.

By MAINS SUPERINTENDENT.

Two or three points coming from practical experience in connection with distribution work may be of interest to your readers. I do not know that there is very much sequence or connection between the points, but as they arise from a practical man's daily work, they may fit in very well with the working requirements of some other man in the profession.

One of the first points that arises is the relative value of stoneware and iron conduits. At the first glance, it would seem that iron being a metal would not only resist the strokes of a navvy's pick better than anything in the nature of a drain pipe, but would also form a good earth circuit to obviate any risk of electrolysis.

Before laying down a system of iron pipes, however, the question of joints should be carefully gone into, as on the one hand it would be foolish to run out iron pipes in very short lengths and run up the cost of junction ends where so much natural advantage in the production of long lengths is to be found, but on the other hand, the question of bends comes in, in a very serious manner, and may prove a pitfall to the unwary.

I have seen a type of conduit having a junction somewhat of the form shown in fig. 1, and where these can be used on

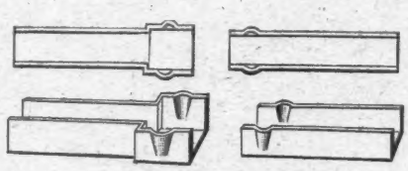


Fig. 1.

the straight run, there is probably no more simple and efficient way of putting conduits together, inasmuch as any navvy can drop one piece of trough in on top of another and allow them to fit themselves by means of the lips and grooves. There is, however, so far as I am aware, no provision for rounding a sharp corner except by ordering up special patterns of bends, and this sort of thing, as every engineer will know, is rather inclined to be a nuisance, when a quick job has to be carried out.

Our old friend the stoneware conduit does not present so much difficulty in the matter of bends, inasmuch as a bend of stoneware can be chipped in a cautious manner, so as to equalise the effect of a joint. The type of pipe which I sketch herewith (fig. 2) goes very well both on straight work

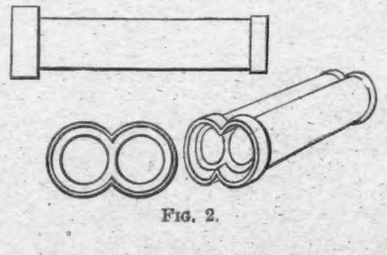


Fig. 2.

and on curves, but it is necessary on curves to chip the joint away a little, as otherwise the joint will only be enough to keep dirt out, water always getting in if it is present, even if the joints are wiped over with hot resin, because the weight of the earth on top of the pipe will break the joint. It is therefore necessary to keep a very careful eye of supervision on the men who are carrying out stoneware conduit work round corners. Where large pipes are laid in this way it is best to lay a bed of concrete underneath the pipes, unless the ground is very firm, and some people cover the line of piping with concrete as well. This, however, is a very expensive job and makes the arrangements less get-at-able.

Another point that I have come across in cable work has

been the question of joint or disconnecting boxes. Other things being equal, there is a very reasonable feeling in favour of a good large joint box; the parts are not so crowded together, there is usually plenty of conducting section on the inside fittings, and there is not so much danger of trouble being caused by accidental contact from cable to case; at the same time, I have known some very curious cases in large boxes of this sort of breakdown of insulation, and general upset, because the bitumen used was too chippy, and it should be very carefully remembered that, especially for large boxes, the composition should be of a very elastic nature, so that it clings to the sides of the box and to the cable and does not crack. This elastic compo. will not chip out, and has to be melted out, hence it gives a good deal of trouble and is not altogether well liked by the jointers on this account, but it should be remembered that joint boxes are not intended to be opened every week. Quicker work can be done if hard compo. that chips with the chisel is used, but the elastic compo. is much safer. In filling up the joint boxes it should first of all be seen that the joint itself is perfectly clean, so that the compo. will cling to it, then the box should be filled up to the level of the joint, the cover put on and more compo. poured in through the hole in the cover, and then left for a day or two. After this it should be topped, that is to say, still more compo. poured in to compensate for the shrinkage, which, of course, goes on as the heat comes out of the bitumen mixture.

With these precautions it is very seldom found that even with a large joint box there is trouble with exposed connections.

I am aware that the above remarks cannot be considered anything more than a note or two out of my pocket-book; but as they are the result of practical trouble, it is hoped that they will be useful to other men in the same line.

EXPIRING PATENTS.

(Continued from page 684.)

14,001. "Railway signals, &c." E. Tyer. July 20th, 1894. Controlling traffic on signal lines; staff and ticket systems. When the lid is opened at one station to insert a staff, tail pieces depress two levers, one of which breaks the circuit to the distant station, and the other holds the staff until the lid is closed and the circuit re-made. The staff then passes down an incline and depresses a spring lever by which an armature is brought up to its electro-magnet and a contact made to send a current to a second electro-magnet at the distant box. This magnet removes a catch from a spring plunger, so that a push can be depressed to eject the end staff inserted there. As the spring plunger moves back it breaks the circuit, so that it becomes locked on its return until it is again released by inserting another staff in the distant box. The inclined bar may be spiral to hold a large number of staffs, or the apparatus may be modified for tablets.

14,246. "Electric distribution." C. F. Scott, Pennsylvania, U.S.A. July 24th, 1894. (Date claimed under Sec. 103 of Patents, &c., Act, 1883, February 26th, 1894.) Relates to a method of transforming alternate currents of one number of phases into currents of different numbers of phases, and of higher or lower potential. To change, for example, two-phase currents into three-phase, a transformer is connected in each phase of a two-phase generator. The secondary of one of these transformers is made 0·866 of the size of the other. One end of this smaller secondary is connected to the mid-point of the larger secondary, and the remaining end with the two ends of the larger secondary form the three terminals of the three-phase arrangement. The apparatus can be reversed to transform currents from three-phase into two-phase.

14,602. "Electro-motors." J. G. B. A. Canet and A. Hillairet, both of Paris. July 30th, 1894. Relates to apparatus for controlling the working of electro-motors used for operating such things as elevators, winches, travelling bridges, ships' and other turrets, and tramway and railway vehicles, the movements of which are limited in extent and require to be reversed from time to time. The apparatus has a vertical operating shaft carrying the movable part of a stop-switch and the movable part of a reversing switch. This shaft is geared to an intermediate horizontal shaft from which motion is transmitted to a brush carrier, mounted on a fixed vertical shaft by means of an electro-magnetic clutch. The clutch consists of a double armature keyed to the horizontal shaft and a pair of electro-magnets loose thereon and in gear with the brush carrier; several modifications are, however, described. The brush carrier consists of an arm carrying a brush holder and a short-circuiting contact piece and furnished with a spring for automatically returning it to zero position when the clutch is disengaged. The brushes bear upon a commutator, the segments of which are connected to a rheostat, consisting of a series of flat copper coils separated by insulating disks. In order to start the motor, the handle is moved in one direction or the other from zero position, by which means the vertical shaft is caused to operate the stop switch so that current is sent into one of the magnets of the clutch, which then engages with its armature. At the same time the reversing switch sends current into the motor in the desired direction. By continuing the motion of the handle, the short circuit is broken and the brushes are caused to move over the commutator of the rheostat. In order to stop the motor, the handle may be returned to zero position, or the operation may be effected automatically by causing a projection on the machine driven by the motor, to break the circuit of the clutch magnet, which is then disengaged from its armature by a spring, and the brush carrier returned to zero position by a spring.

14,988. "Electrolysis." W. L. Wise. (E. Solway, Brussels.) August 4th, 1894. Relates principally to using what are here called "electrolytic tables." These tables consist of parallel sheets of metal placed close together like the leaves of a book, and alternately connected to the two poles, but insulated from one another. The edges, therefore, are the only active parts, and the electrolyte is caused to flow continuously over these edges in a thin stream by any suitable arrangement. The evolved gases are collected by grooves in a plate arranged over the electrolytic table. The gases are finally collected in and led away by separated mains. Modifications may be made; for example, when threads or wires are sufficient to carry the current they may be employed instead of metal sheets; or again, the conducting strips may be arranged in cylindrical form.

15,129. "Exhausting electric lamp bulbs." A. Malignani, Udine, Italy. August 8th, 1894. The bulb is provided with a tube at a point in which is placed some material, which, on being heated, will evolve gases or vapours which will combine with the gases or vapours generated when the filament is raised to intense incandescence, and form a liquid or solid therewith. The bulb is then exhausted by means of a vacuum, after which the end of the tube is closed up, and a current sent through the filament, while heat (as of a spirit lamp) is applied at the point at which the material above referred to is placed. The liquid or solid which forms collects in the tube, and the bulb is closed near the top. The following are given as examples of materials which may be placed in the tube:—Arsenic, sulphur or iodine, which may be mixed with such liquids as essence of tremandra or alcohol. A small quantity of ether or other hydrocarbon vapour may be introduced into the bulb.

15,276. "Electrolysis." M. Kiliani, Neuhausen, Switzerland; W. Rathenau, Berlin; C. Suter, Neuhausen; and Elektrochemische Werke, Berlin. August 10th, 1894. Relates to diaphragms which consist of permeable membranes such as of parchment, glass-wool, asbestos card, or the like, supported by two sets of laths, bars or rods, of acid and alkali proof material, as of glass or porcelain, placed either opposite each other, and breaking joint with each other, in the same plane with each other, or at right angles to each other. The diaphragms may be built up of any shape, being carried by end frames which are provided with a series of recesses or notches into which the ends of the inner row of rods are fitted, while the ends of the outer rods are secured in position by rubber bands or by wire. Where the diaphragm is very large, similar frames with bands of rubber or wire arranged in intermediate positions may be provided.

17,529. "Telephonic apparatus, &c." F. H. W. Higgins. September 14th, 1894. Telephones are built up on beds of rigid non-metallic material such as slate, and preferably have two coils wound one right-handed and one left, but so connected as to send a current the same way through both. The transmitter is provided with an ordinary mouthpiece or a speaking tube. The receiver has a thick large diaphragm formed of sheets of iron, and a sheet of cardboard secured together by shellac, &c., cut radially. The permanent magnets have one pole of each attached to an iron disk, the other poles being spaced round the edge of the diaphragm. The central pole piece is in the form of a tube and supports a coil. An ear piece is attached to the slate bed, and has a short length of velvet lining. Silent closets are provided with tubes or openings lined with velvet so as to allow of the passage of air but prevent the passage of sound.

17,774. "Telegraphs; telephones." Phonopore Co., Ltd., and E. W. Smith. September 18th, 1894. Relates to call apparatus for telephones, harmonic telegraphs, &c., which are connected to the line wire through a condenser phonopore. A permanent magnet is arranged with soft iron poles having windings which can be supplied with a vibratory current from the phonopore. On receiving such a current the magnet ceases to attract its armature which being released closes the local circuit of an electro-magnet to the armature of which is attached a bell hammer or some visual signal. When the armature of this electro-magnet is attracted it closes a local battery circuit through the winding of the permanent magnet poles, and so enables these to attract their armature in spite of the vibratory current. This breaks the local circuit of the electro-magnet, and so the action goes on until the vibratory current ceases.

18,215. "Railway signals." H. H. Lake. (Hall Signal Co., New York.) September 25th, 1894. Semaphores; controlling, &c., signals; systems automatic. The semaphore is counterweighted to move to "danger," is moved to "safety" by an electro-motor winding up a rope, and is held at "safety" by an electro-magnetic brake which also serves to retard the movement of the semaphore before it reaches the end of its movement. The electro-motor is enclosed in a box on the signal post and the rope is connected to a balance lever and is wound on a drum geared to the motor. A worm wheel and worm which may or may not be on the drum shaft operates an arm carrying a pair of contact springs. The latter, which are normally in the position shown, work over contact blocks, the upper ones of which are connected to the stops of the armature of a relay magnet which may be arranged in any circuit, but which for the purpose of automatic signalling is connected to the rail so as to be short-circuited when a train enters a section. The lower blocks are electrically connected to the main battery and to the magnet. When the parts are in the normal position, the signal is held at safety by the electro-magnet the circuit of which is completed through the small battery and two contacts. Now, when a train enters the section the relay magnet is short-circuited, thereby breaking the circuit of the electro-magnet and allowing the signal to freely move to "danger." In moving to danger the arm carrying a pair of spring contacts moves to the left, and before the semaphore has completed its movement the contacts complete the circuit of the electro-magnet which then acts to retard the signal and the other contacts partly complete the motor circuit, so that when the armature of the relay magnet is again attracted the motor will act to lower the signal and move the parts back to the normal position. In a modification, one battery only is used for the motor and brake magnet circuits.

20,259. "Electrolysis." C. Kellner, Vienna. October 23rd, 1894. Relates to apparatus for the electrolysis of alkaline salts with the aid of a stationary mercury cathode in which the amalgam formed has its location changed by the shifting of a partition from the decomposing chamber, where it is produced to a combining chamber, in which it is decomposed and the cation combined with water, an acid, or other body. The vat containing the electrolyte has a trough containing water, acid, &c., and a non-conducting bell or several bells connected together, dipping into a layer of mercury confined between the projecting borders of openings in the trough. The lower edges of the bells have slots, or the floor of the trough has notches, so that the bells may be moved without displacing the mercury. The mercury forms the cathode, and horizontal or vertical plates the anodes. On passing the current, the parts being in the normal position, chlorine is evolved and is collected by tubes, while sodium amalgam forms on the mercury. On shifting the bells sideways, the decomposition of the electrolyte proceeds, sodium amalgam forming with the mercury to the right of each opening, while the previously formed amalgam is now in contact with the water, &c., in the trough or in compartments in free communication therewith. By this means caustic soda solution, &c., is formed, and mercury remains for re-use when the bells are again shifted laterally. In a modification, the arrangement is reversed, the bells contain the water, &c., while pipes are attached thereto to collect the hydrogen evolved. In another modification the bells or the troughs are mounted on a vertical shaft so as to rotate instead of moving to and fro. In a further modification a third electrode is employed in the combining chamber to facilitate the decomposition of the amalgam.

20,397. "Electric lamps." H. J. Creffield, Kent. October 25th, 1894. Arc lamps with cut-out devices for cutting out the lamp at any predetermined time. According to one form, a pivoted lever carries at one end the armature of an electro-magnet which is attached to, but insulated from, a contact piece, and is geared with a clutch. When the circuit is completed, the current passes through a series coil on the electro-magnet, a contact piece and the armature of a second electro-magnet. The attraction of the first magnet armature operates the clutch and permits the carbons to come into contact. The second magnet is now energised and the circuit broken. The strength of the current which now passes partly through the series coil and shunt coil of the first magnet, being thus diminished, the lever is drawn down by a spring to strike the arc, when, owing to the consumption of the carbons, an insulating stop presses a spring or flexible blade against a contact piece, the current then passing through the first magnet until a circuit is completed through contact pieces by the attraction of the electro-magnet armature. The lamp is then short-circuited through the electro-magnet. A modification is described, in which a conducting piece is substituted for the insulating stop.

20,798. "Railway signals." W. P. Hall, New York. October 30th, 1894. Systems, automatic:—The main object of the invention is to enable the lengths of the block section to be increased without giving false signals owing to imperfect insulation of the rails. The signals are electrically operated, and each block section is divided up into two or more blocks. In order to more completely protect the trains, each block section may be made to include one or more sub-sections of the adjacent block. The signals are in normally de-energised circuits.

20,807. "Telegraph transmitters." H. A. Taylor and J. A. L. Dearlove. October 30th, 1894. Transmitting instruments of the type described in specification No. 12,407 A.D. 1894 (see page 684), are provided with arrangements for sending curb currents and for recording the message at the transmitting station, this method being applicable for ordinary key signalling. One of the above described automatic transmitters has two levers connected to a curb battery. These levers are mounted on an adjustable frame, and are actuated by a cam lever, so that only one can be in contact with a stop at once. This stop is connected to a line, and the cam lever through another line with two other lines, these latter being connected to two stops. For recording the messages signalled at the transmitting station, the coils of two relays, or a double-wound relay, are connected between the three latter lines, and the armature or armatures are made to operate a Steinheil or Herring recorder. In the case of an ordinary double contact key, the back bar is split and relays connected between the two parts and one terminal of the battery.

(To be continued.)

NEW PATENTS APPLIED FOR, 1908.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

7,045. "Improvements in dynamo-electric machines." J. E. Noeggerath. (Date applied for under Sec. 91 of the Act, April 1st, 1907, being date of application in United States.) March 30th. (Complete.)

7,565. "Improvements in current-conducting wire terminals." W. Vernum. April 6th.

7,569. "Improvements relating to electric accumulators or secondary batteries." E. H. Hungerbuhler. April 6th.

7,571. "Improvements in and relating to field magnets for dynamo-electric machines." A. G. Brookes. (Cushman Electric Co., United States.) April 6th. (Complete.)

7,586. "Electrically-operated signals for railroads." H. J. Jones. (Date applied for under Sec. 91 of the Act, May 13th, 1907, being date of application in United States.) April 6th. (Complete.)

7,593. "Improvements in watertight holders for incandescent electric lamps." E. G. Byng and C. E. Gunner. April 6th.

7,614. "Improvements in re-wireable electric enclosed bridge fuses." H. H. Berry. April 6th.

7,621. "Improvements in alternating-current electric motors of the repulsion type." Ateliers Thomson-Houston. (Date applied for under Sec. 91 of the Act, April 6th, 1907, being date of application in France.) April 6th. (Complete.)

7,644. "Improvements in apparatus for restricting the maximum current passing in electric circuit." W. Fennell and W. P. Perry. April 7th.

7,645. "Improvements in charging for electricity supplied." W. Fennell and W. P. Perry. April 7th.

7,646. "Improvement in electric meters for limiting the amount of electrical energy which may pass through a circuit to a pre-determined quantity." W. Fennell and W. P. Perry. April 7th.

7,668. "Improvements in electrical methods of transmitting power in a variable and flexible manner." W. B. Parker. April 7th.

7,670. "Improvements in safety cut-outs for use in connection with the overhead wires of electric traction systems." A. E. Dixon. April 7th.

7,674. "New or improved means for attaching shades and reflectors to incandescent electric lamps." C. W. Dawson. April 7th.

7,711. "Improvements in or connected with conduits for electric leads or cables." G. G. Sarney. April 7th.

7,730. "Improvements in telephone relays." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) April 7th.

7,736. "Improvements in or relating to couches for radiographic and other like purposes." J. T. Hill and E. L. Hill. April 7th.

7,740. "Improvements in or connected with globe galleries for gas burners, electric lamps and the like." S. Mundler. April 7th.

7,747. "Improvements connected with high tension magneto ignition apparatus for internal combustion engines." Chambers Motors, Ltd., and A. M. Patton. April 7th. (Complete.)

7,750. "Improvements in electric locomotives." E. C. Ketchum. April 7th. (Complete.)

7,800. "Improvements in electric reciprocating tools." A. F. Carver. April 8th. (Complete.)

7,811. "Improvements in the controlling of electric motors." Sir W. G. Armstrong, Whitworth & Co., Ltd., and F. Harlaw. April 8th.

7,822. "Improvements in connection with electric lamps and their circuits." H. W. Handcock, A. H. Dykes, C. H. Stearn and C. F. Topham. April 8th.

7,844. "Improvements in and relating to electric motor controllers." The British Thomson-Houston Co., Ltd., H. C. Hastings and W. L. Wise. April 8th.

7,845. "Improvements in and relating to alternating electric current motors." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) April 8th. (Complete.)

7,853. "Improvements in connectors for electric conductors." A. Morgan. April 9th.

7,854. "Improvements in electrical machines." J. P. Hall. April 9th.

7,865. "Electric incandescent lamp wrapper." F. Harrison. April 9th.

7,886. "Improvements in or applicable to electric meter systems." Nalder Bros. & Thompson, Ltd., H. W. Handcock and A. H. Dykes. April 9th.

7,905. "Improved means for attaching telegraph, telephone and other wires or conductors to insulators or other supports." E. W. Gover. (W. M. Robinson, Transvaal.) April 9th.

7,910. "Improvements in pyrometers or thermometers of the thermo-electric or electrical resistance type." Siemens Bros. & Co., Ltd. (Siemens and Halske Akt.-Ges., Germany.) April 9th. (Complete.)

7,916. "Improved automatic electric switch." W. H. Smith and A. Aufholz. April 9th.

7,923. "Improvements in or relating to electric furnaces." H. Nathusius and Westdeutsche Thomasphosphatwerke Gesellschaft mit Beschrankter Haftung. (Application for Patent of Addition to No. 7,188/08.) April 9th. (Complete.)

7,930. "Improvements in and connected with electrical ignition devices." C. Esner. (Application for Patent of Addition to No. 28,738/07.) April 9th. (Complete.)

7,941. "Improvements relating to electric brakes." P. S. Turner. April 9th.

7,943. "Improvements in dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) April 9th. (Complete.)

7,944. "Automatic frog for overhead trolleys." W. Gray. April 10th.

7,954. "Improvements in and relating to the covering and fire-proofing of electric wires, firemen's dress and the like." R. S. Wiseman. April 10th.

7,961. "Improved telephone bridge for measurements of ohmic resistances, not affected by the inductance of such resistances." A. S. M. Sorensen. April 10th.

7,964. "Improved apparatus for rendering sanitary telephone compartments and the like." T. T. Baker. April 10th.

7,969. "Dynamo worker for bicycles, motor-cars and other vehicles." J. Mabbett and J. H. Alpass. April 10th.

8,013. "Improvements in telegraphically transmitting signals by means of a perforated strip." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) April 10th. (Complete.)

8,017. "Improved process for the manufacture of an insulating material." H. Branco and G. Gumpert. April 10th. (Complete.)

8,018. "Improvements in and relating to ampere-hour meters." W. Meterling. (Date applied for under Sec. 91 of the Act, August 7th, 1907, being date of application in Germany.) April 10th. (Complete.)

8,065. "Improvements in dynamo-electric machines also applicable as rotary electric transformers or motor-generators." Crompton & Co., Ltd., J. C. Macfarlane and H. Burgh. April 11th. (Complete.)

8,093. "Improvements in and relating to electrical heating." E. C. R. Marks. (J. Roberts, Natal.) April 11th.

8,097. "Improvements in and relating to wireless telegraphy." A. Arton. (Date applied for under Sec. 91 of the Act, April 11th, 1907, being date of application in Italy.) April 11th. (Complete.)

8,101. "Improvements in cooling the commutator of a dynamo-electric machine." Siemens Bros. & Co., Ltd., and C. M. Toplis. (Application for Patent of Addition to No. 7,255/1906.) April 11th. (Complete.)

8,104. "Improvements in and relating to the manufacture of filaments for illuminating and heating purposes." G. Michaud and E. Delasson. (Application for Patent of Addition to No. 4,461/1908.) April 11th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool; price, post free, 9d. (in stamps).

1907.

Electric Lighting of Railway and other Vehicles. C. A. Park and C. L. Mason. 1,373. January 18th.

Compensated Dynamo-Electric Machines of the Commutator Type. British Thomson-Houston Co. (General Electric Co., United States.) 6,649. March 19th.

Electro-Magnetically Operated Switches Particularly Adapted for Controlling Electric Motors. E. Schattner and R. Amberton. 6,864. March 21st.

Alternating-Current Series Commutator Motors. J. Keith and C. Tuson. 6,906. March 22nd.

Apparatus for Magneto-Electric Ignition for Internal-Combustion Engines. G. Fuller and A. T. Fuller. 6,920. March 22nd.

Electric Arc Lamps. W. J. Davy. 6,943. March 22nd.

Electric Motor Control Systems for Towing and the like Systems. British Thomson-Houston Co. (General Electric Co., United States.) 7,131. March 25th.

Electric Lifts or Hoists. R. Waygood & Co. and D. Bone. 7,737. April 2nd.

Electric Furnaces. S. O. Cowper-Coles. 7,742. April 2nd.

Means for Adjustably Supporting Electric Incandescent Lamps, and Shades or Reflectors Therefor. J. Rawlings and R. T. Smith. 8,151. April 8th.

Telautographs. F. Ritchie. 9,010. April 18th.

Electric Telegraph Apparatus. W. Sutcliffe. 10,091A. May 1st. (Date applied for under Rule 13, May 1st, 1907.)

Method of Generating High-Tension Direct Electric Currents. J. S. Highfield. 11,166. May 13th.

Tramway Conduit Points. W. Kneen and H. C. King. 11,523. May 17th.

Electrically-Actuated Fire Alarms. J. Tatlock and A. C. Horne. 12,173. May 27th.

Electric Insulators. British Thomson-Houston Co. (General Electric Co., United States.) 13,196. June 6th.

Electric Reactances and the like. British Thomson-Houston Co. (General Electric Co., United States.) 13,739. June 13th.

Dynamo-Electric Machines. J. E. Noeggerath. 14,876. June 27th. (Date applied for under International Convention, June 30th, 1906.)

Ships' Compasses. J. W. Gillie. 15,493. July 5th.

Starters for Electric Motors. W. C. Mayo and J. Houlehan. 16,366. July 16th. (Date applied for under International Convention, February 11th, 1907.)

Dynamo-Electric Machines. Bruce Peebles & Co. and J. L. La Cour. 16,710. July 22nd.

Space Telegraphy. J. S. Stone. 17,695. August 2nd. (Date applied for under International Convention, August 3rd, 1906.)

Laying of Underground Electric Conduits and Laying Conductors Therein. A. E. H. Dussek and A. S. Dussek. 18,849. August 21st.

Electric Hot Water Radiator for Heating Buildings or the like. C. G. Nobbs and C. G. Nobbs, Jun. 19,875. September 5th.

Process of Manufacturing Metal Filaments from Colloidal Metals. V. Scholz. 20,372. September 12th.

Mercury Interrupters for Electric Currents. L. J. B. Drault. 20,670. September 17th. (Date applied for under International Convention, September 21st, 1906.)

Method of Manufacturing Moulds Used in the Electrolytic Manufacture of so-called Honeycomb Radiators and Apparatus Connected Therewith. S. Friedheim. 20,932. September 20th. (Date applied for under International Convention, November 27th, 1906.)

Control of Electric Motors. Allgemeine Elektricitäts Ges. 21,670. September 30th. (Date applied for under International Convention, October 1st, 1906.)

Microphones and Telephonic Receivers. V. Tardieu. 25,448. November 16th.

Sparking Plugs. A. Dumaire and E. Moonen. 26,747. December 3rd. (Date applied for under International Convention, December 8th, 1906.)

Electrical Box Couplings. J. J. Rawlings and R. T. Smith. 27,400. December 11th.

Wireless Telephony. A. Skinacker and A. Plisnier, Jun. 5,853. March 11th.

Vehicle with Collapsible Pole for Radio-Telegraphy. L. Solari. 5,987. March 13th.

Bow Trolleys or Collectors for Electric Railways and Tramways. Brecknell, Munro & Rogers, Ltd., and E. M. Munro. 6,064. March 13th.

Electro-Magnets. D. K. Morris and G. A. Lister. 6,023. March 13th.

Protective Fuses for Use on Electrical Circuits. H. W. Handcock, A. H. Dykes and R. T. Smith. 6,224. March 14th.

Electric Telegraphy. I. Kitsee. 6,279. March 15th.

Electric Trembler Coils and Contact Breakers. L. Metcalfe. 6,388. March 15th.

Electric Lighting of Railway and other Vehicles. Sir W. G. Armstrong, Whitworth & Co. and J. Holmer. 6,409. March 16th.

Electrical Ignition Apparatus. J. A. Torrens. 6,417. March 16th.